

Septic System Impacts on Stormwater and Impaired Waterbodies

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complex world



East and West Spring Lakes

- Septic systems were constructed between the 1950s and early 1980s
- Many are in failure and do not meet current regulations
- Area ultimately discharges to Charlotte Harbor and Peace River

• Project goals:

- Abandon 2,455 septic systems by connecting them to a newly constructed wastewater system
- Replace deteriorated culvert pipe and widen and/or restore grassy swale areas to increase percolation, infiltration, and storage
- Reduce nutrients, sediments, and bacteria discharging to the Peace River
- Implement a water quality monitoring program to provide feedback on the pollutant removal efficiency of the best management practices (BMPs)
- Implement a public education program on the benefits of the project and distribute literature on BMPs for pesticides, herbicides, and fertilizers.









Canal and Groundwater Monitoring

- Sampling in canals and groundwater wells ongoing since 2012
- Originally 21 canal locations, 5 upstream, were selected
 - Slight modifications made to canal locations in 2015
 - At end of project, 16 canal sites (all in project area) still active

• Originally 50 wells were set up at random locations using a grid

- Additional wells added in areas with known septic system failures
- Over time, wells phased out at request of homeowner or due to damage
- At end of project, 26 groundwater wells still active



Storm Event Monitoring

- Monitoring to meet grant requirements
- 5 stormwater outfall monitoring sites
 - Selected to represent about 10% of the outfalls
 - Captured discharges to main waterbodies

Required to collect 3-4 samples pre- and post-construction

- 4 pre-construction samples from September 2015 May 2016
- 2 interim samples in Phase II in September 2017 October 2017
- 4 post-construction samples from July 2018 October 2018











Sampling Parameters

Parameter	Analysis Type	Sample Type
Total suspended solids	Laboratory	Composite
Total phosphorus	Laboratory	Composite
Nitrate + nitrite	Laboratory	Composite
Total Kjeldahl nitrogen	Laboratory	Composite
Ammonia	Laboratory	Composite
Total nitrogen	Laboratory	Composite
Biochemical oxygen demand	Laboratory	Composite
Fecal coliform	Laboratory	Grab
Temperature	Field	Meter
рН	Field	Meter
Specific conductance	Field	Meter
Dissolved oxygen	Field	Meter
Turbidity	Field	Meter
Water level (at ground water monitoring wells)	Field	Meter
Rainfall	Field	Meter



Sampling Frequency

- Surface water and groundwater samples were collected every other month from June 2012 through December 2017
 - Samples were not collected in the same month as the pre-construction storm event sampling, which made data correlations difficult

• Frequency was modified to better capture conditions during the rainy season when septic systems were having the greatest impact on water quality

- Monthly sampling during the rainy season of July through October and sampling once in January and in once in April during the dry season
- Storm event collection triggered by rain events of generally 0.2 1.5 inches

Standards Used for Comparison

• Canals and stormwater outfalls:

- West Central Nutrient Region: TN = 1.65 mg/L and TP = 0.49 mg/L
- Fecal coliforms = 400 cfu/100 mL

• Ground water monitoring wells:

- Drinking water standards:
 - -NOx = 10 mg/L
 - Fecal coliforms = presence detected





Phase I Construction Status

- Swales regrading and rehabilitation began in September 2017 and were completed in March 2018 near SRC and April 2018 near EWW
- Connections in the SRC outfall basin began in mid-July 2018 and were largely completed by the end of October 2018
 - Three of the four post-construction samples were collected in mid- to late-July 2018 and sampling was completed in October 2018
- Connections in the EWW outfall basin had not begun when the post-construction sampling was completed



Phase I Canal Results – TN and TP





Phase I Groundwater Well Results – NOx





Phase I Groundwater Wells Results – TP





Phase I Storm Event Results – TN and TP





Phase II Construction Status

- Swales regrading and rehabilitation began in February 2016 and completed in January 2017 near WSL, February 2016 near TWW, and January 2017 near ESL
- Connections in the WSL outfall basin began at the end of July 2016 and were largely completed in February 2017
 - One septic system across the street from the WSL sample location remained in place during the postconstruction sampling and appeared to adversely influenced sample results
- Connections in the TWW outfall basin began at the end of July 2016 and was largely completed in September 2018
- Connections in the ESL outfall basin began in mid-May 2017 and were largely completed in November 2017



Phase II Canal Results – TN





Phase II Canal Results – TP





Phase II Groundwater Wells Results – NOx





Phase II Groundwater Well Results – TP





Phase II Storm Event Results – TN





Phase II Storm Event Results – TP





Project Water Quality Benefits Calculations

- Charlotte County Utilities measured TN concentrations in a lift station near the project area that receives effluent from low-pressure sewer tanks that collect individual household effluent
 - Average TN concentration over a one-year period was 67 mg/L
 - Assumed to be the TN concentration in the septic tank effluent
- Water usage per month for both the lift station area and the East and West Spring Lakes area were recorded over a one-year period for comparison
 - Average household used water 10.3 months per year
 - Amount of water use per household was 139.7 gallons/day
 - 16% estimated to be used for irrigation so the amount of water in each septic tank estimated as 117.3 gallons/day



Project Water Quality Benefits Calculations, cont.

- Average TN concentration and septic system use per household from the lift station study were applied to the number of homes to be converted from septic-to-sewer
- Average TP concentration was taken from the STEPL model used in the grant
- The measured percent reductions were then applied to determine the postconstruction loads and load reductions



Phase I Estimated Load Reductions

- The calculated load reductions are lower than expected
- This is largely due to very few septic systems being connected at the time of the post-construction sampling

Annual Values	TN (lbs/yr)	TP (lbs/yr)
Pre-construction Loads	9,963	3,497
Post-construction Loads	7,639	3,893
Load Reduction	2,324	-396
Percent Reduction	23%	-11%



Phase II Estimated Load Reductions

- Measured benefit to stormwater quality from the stormwater system improvements and septic system removal
- The monitoring results from the groundwater wells also show an improvement

Annual Values	TN (lbs/yr)	TP (lbs/yr)
Pre-construction Loads	35,350	12,408
Post-construction Loads	23,334	9,577
Load Reduction	12,016	2,831
Percent Reduction	34%	23%



Items to Note

- Measured load reductions are for the stormwater runoff only
- Marked improvement is expected as the remaining septic systems are connected
- Additional reductions are expected over time as seen in the North Shore area
- Septic system removal has an impact on groundwater levels
 - Will have an impact on water quality and it will take time for water levels to reach a new equilibrium
 - Measured groundwater levels were 0.4 feet lower after septic system removal
- Septic systems in place for decades and will take time for the nutrients to be flushed out
 - Supported by a Western Michigan University ongoing study that measured groundwater velocities
- Septic systems throughout the project area had failed and the impacts from these failures may have contributed to an extended period of higher nutrient concentrations



Questions?

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