GEL Engineering LLC
a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.769.7378 F 843.769.7397

www.gel.com

February 12, 2013

Mr. Robert Klink, P.E.
Storm Water Program Manager
Beaufort County Public Works
120 Shanklin Road
Beaufort, South Carolina 29906

Re: Year 2011-2012 Annual Report
Beaufort County Water Quality Monitoring
Beaufort County, South Carolina

Dear Mr. Klink:

Enclosed is the Year 2011-2012 Annual Report for the project, titled "Beaufort County Water Quality Monitoring, Beaufort County, South Carolina." If I can answer any questions or provide you with additional information regarding this report, please contact me at (843) 769-7378.

Yours very truly,

Joseph E. Coffey, Jr., P.E.
Director

enclosures

fc: BECY00111_2011-12_Report.doc

GEL Engineering LLC

Environmental | Engineering | Surveying

Year 2011 – 2012 Report
Beaufort County Stormwater Quality Monitoring
Beaufort County, South Carolina

Submitted to:

Beaufort County Public Works
120 Shanklin Road
Beaufort, South Carolina 29906

Prepared by:

GEL Engineering, LLC
2040 Savage Road
Charleston, South Carolina 29407

February 12, 2013

YEAR 2011-2012 REPORT

Beaufort County Water Quality Monitoring

Beaufort County, South Carolina

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YEAR 2011-2012 REPORT

Beaufort County Water Quality Monitoring

Beaufort County, South Carolina

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YEAR 2011-2012 REPORT

Beaufort County Water Quality Monitoring

Beaufort County, South Carolina

EXECUTIVE SUMMARY

The Beaufort County water quality monitoring program (WQMP) was developed to achieve the four primary goals identified in the Storm Water Management Plan (SWMP) and support the county's future implementation of this plan. The four primary goals are: 1) establish baseline water quality; 2) determine and track long-term trends to measure effectiveness of current best management practices (BMPs); 3) measure efficiency of selective BMPs, and; 4) determine runoff quality from single land use areas. Table 1 shows the recommended tributary sampling as indicated in the SWMP and Table 2 shows the current tributary sampling locations. GEL Engineering, LLC (GEL) was first selected by Beaufort County in 2007 to implement the water quality monitoring program for two years. In 2009, GEL was selected to continue the water quality monitoring program, for the potential of up to five years.

Previous years of the WQMP included sampling for bacterial source tracking (BST) to attempt to establish the source of fecal coliform contamination. During Year 5, no funds were spent to conduct BST due to the inconclusive nature of data derived during past BST and lack of significant advancements in the technology.

This report provides an overview of Year 5, evaluates the five years of water quality data (2007-2012), and provides recommendations with regard to the primary goals of the WQMP. The activities and observations during Year 5 include the following:

- The concentrations of fecal coliform exceed the state shellfish harvesting waters standard of 14 CFU/100 mL at all sample stations.
- Three years of consistent baseline water quality data were obtained for sample station Southside. Beaufort County elected to discontinue data collection at this site.
- Two sample stations, BECY-18 and BECY-19, were added in order to compare the baseline water quality data between sample stations that drain into Battery Creek; one of which drains from a mostly undeveloped area (BECY-18) and one that drains a mostly developed area (BECY-19).
- The total phosphorus concentrations observed at sample station BECY-15 regularly exceeded the established "critical exceedance concentration" during Year 5.
- Excluding the observation noted above, data collected in Year 5 did not regularly exceed action levels for parameters with critical exceedance concentrations.

Additionally, CDM Smith and GEL reviewed the water quality data since the inception of the WQMP (2007-2012). The following observations are drawn from this review:

- Given the dataset as a whole, the results signify 'good' water quality, as indicated

by a lack of chronic or routine critical concentration exceedances. Some stations have concentrations of certain parameters that are higher in comparison to other stations, but these concentrations are typically below critical exceedance concentrations.

- Increasing trends for ammonia and TKN (TKN) were observed at BECY-1, BECY-2, and BECY-3. The increasing trend is due to several high concentrations observed during Year 5. However, the observed concentrations are below the critical exceedance concentrations.
- Aside from the referenced ammonia and TKN trends, no other significant trends were observed, which indicates little change in the overall water quality at these stations.

In addition, CDM Smith and GEL have reviewed the WQMP in regards to the four primary goals identified in the SWMP. The following recommendations have been made in respect to these goals:

- Continue monitoring at long-term trend analysis stations. At least 10 years of data is needed to effectively monitor the presence of long-term trends.
- Continue monitoring existing water quality stations to establish baseline water quality, especially in developed areas that may benefit from a future water quality control retrofit.
- Due to the difficulty and expense of collecting data to measure BMP efficiency, as well as the amount of literature available to document BMP efficiency, traditional BMP monitoring should be a lower priority for future monitoring efforts. It should be noted that monitoring at the Eagles Pointe BMP (pond system) indicated positive results for stormwater treatment.
- A large amount of literature and data also exists to estimate the runoff concentrations from single land use areas (i.e. high density residential); therefore, monitoring of runoff from single land use areas should be a lower priority for future monitoring efforts.
- Continue monitoring the existing list of parameters, which will allow for effective monitoring of the overall quality of surface water and long-term trends in Beaufort County.

YEAR 2011-2012 REPORT

Beaufort County Water Quality Monitoring

Beaufort County, South Carolina

1.0 YEAR 5 WATER QUALITY MONITORING

GEL was retained to continue the water quality monitoring program (WQMP) that was initiated in June 2007. During Year 5, GEL:

- Continued monitoring all established stations in response to a qualified storm event;
- Reported sample values exceeding "action levels" to Beaufort County for those parameters with SCECAP-based "critical exceedance concentrations;"
- Routinely met with Beaufort County to review the latest data, and;
- Made adjustments to sample locations based on the monitoring results, data review, and monitoring program directives supplied by Beaufort County.

Table 2 summarizes the stations monitored during Year 5, including their name, watershed, receiving water body and classification, etc., and most importantly their purpose.

1.1 Sample Locations and Purpose

Since initiation of the WQMP, the selection and identification of appropriate sampling sites for grab sampling and automatic storm event sampling has been based on the water quality sensitivity analysis (modeling), the current level of service for water quality segments, and the existing and future land use classifications. During Year 5, five trending sites and seven existing water quality stations were monitored. Note, sampling from two additional existing water quality site was initiated in Year 5 (refer to Table 2), and their purposes will be further discussed in Section 2.1 of this report. All sites monitored during Year 5 are displayed on Figure 1.

1.2 Qualifying Storm Events

During Year 5, GEL collected grab samples and conducted field measurements at all stations following a storm event that was greater in magnitude than 0.1 inches per hour and that occurred at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event.

GEL also conducted monthly composite storm event sampling at three discrete auto sampler locations, provided that a storm event greater than 0.1 inches in magnitude per hour had not occurred within 72 hours from a previously measurable (greater than 0.1 inch rainfall) storm event. Samples were collected with an automatic sampler that was

established and secured in each of the locations. The automatic sampler collected an aliquot every two minutes for the first 30 minutes following a qualifying storm event for a "grab sample." In past years, the automatic sampler then collected a 15 minute aliquot for the next two and a half hours for a composite sample. However, based on recommendations from the Year 2 Annual Report, the composite auto sample was no longer collected beginning in September 2009. Instead, a second grab sample was collected directly from the water body when GEL personnel collected the initial grab from the automatic sampler (referred to as "Grab After" in Tables 3 through 26).

Beginning in April 2012, this sampling protocol was changed at BECY-9ra. The initial "grab sample" from the automatic sampler is still collected in the manner noted above. However, a composite sample is now collected, which is comprised of an aliquot collected every four hours for up to 16 hours (up to four aliquots). The purpose of this sampling is to determine if parameter concentrations differ over the extended time period from the initial grab sample. Additionally, at the time of sample pick-up by GEL personnel, a sample for fecal coliform analysis is still collected from the waterbody ("Grab After"). These data will be included in an analysis to investigate how fecal coliform concentrations may fluctuate after a rainfall event.

1.3 Sampling/Analytical/QA-QC Procedures

All sampling events were conducted following GEL's Standard Operating Procedures, United States Environmental Protection Agency (EPA) and South Carolina Department of Health and Environmental Control (SCDHEC) approved sampling and analytical protocols, and appropriate safety measures. The table below identifies each parameter analyzed, the method allowable maximum holding time, sample preservative and the analytical method:

Parameter	Holding Time	Sample Preservative	Analytical Method
Fecal Coliform bacteria (FCB)	24 Hours	$Na_2S_2O_3$	Idexx Colilert-18/ATP
Total suspended solids (TSS)	7 Days	4°C	EPA 160.2
Salinity	28 Days	4°C	EPA 120.1
Biochemical oxygen demand (BOD)	48 Hours	4°C	EPA 405.1
Ammonia nitrogen (NH3-N)	28 Days	4°C, H_2SO_4 (pH<2)	EPA 350.1
Nitrite and nitrate nitrogen (NO_3 + NO_2)	28 Days	4°C, H_2SO_4 (pH<2)	EPA 353.1

Total Kjeldahl nitrogen (TKN)	28 Days	4°C, H_2SO_4 (pH<2)	EPA 351.2
Total phosphorus (TP)	28 Days	4°C, H_2SO_4 (pH<2)	EPA 365.4
Chlorophyll-a (chl-a)	48 Hours	4°C	SM10200H
Total organic carbon (TOC) - quarterly	28 Days	4°C, H_2SO_4 (pH<2), zero headspace	EPA 415.1
Metals (cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc) — quarterly	6 Months	4°C, HNO_3 (pH<2)	6010B

Analysis of pH, temperature, dissolved oxygen, turbidity and conductivity was performed in the field using a calibrated Series 4a DataSonde, manufactured by Hydrolab. This allowed parameters with a short holding time to be analyzed in-situ at the time of sampling at each sample location, thus providing more accurate results. Ambient weather conditions noted during each monitoring event included precipitation over the previous 24 hours. In addition, tide levels were noted during the time of sampling at each location. Each of these field parameters was recorded on a Field Data Information Sheet.

While grab samples collected using the auto samplers was described in Section 1.2 of this report, discrete grab samples were collected by lowering a new sampling container directly into the surface water and next transferred to the appropriate laboratory sample containers that have been pre-labeled and containing the appropriate sample preservative. Sampling personnel wore new laboratory-quality, PVC gloves during all sample collection activities, and changed gloves, at a minimum, between each monitoring location. Each sample container was identified with a laboratory label that was completed during collection, and each label included the following information:

- The address and telephone number of GEL;
- A specific client code for the project;
- The parameter to be analyzed from that container;
- The sample identification number/name, and;
- The date and time of sample collection.

A chain of custody form (COC) was completed and maintained throughout sampling and transportation to the laboratory. Samples were transported to GEL Laboratories, LLC, or the designated subcontracted laboratory for analysis. A sufficient amount of freezer packs and/or ice was maintained in the cooler to ensure that the samples remain at the

recommended temperature (4° C). The analytical results were submitted to the County, along with Critical Exceedances, on a monthly basis. (The COC and analytical certificates were not submitted to the County and are not included within this report, but may be supplied upon request.)

2.0 ADJUSTMENTS MADE DURING YEAR 5

Several adjustments were made during Year 5 of the WQMP. During this time, two existing water quality stations were added (BECY-18 and BECY-19). Additionally, sampling was discontinued at one existing water quality sample station (Southside). Lastly, beginning in July 2012, the responsibility for analyzing fecal coliform samples was transferred to the University of South Carolina – Beaufort.

2.1 Monitoring Station Changes

In August 2012, sample stations BECY-18 and BECY-19 were added to the data collection efforts. Sample station BECY-18 drains an undeveloped area adjacent to Battery Creek, while BECY-19 drains a developed area of Battery Creek. Battery Creek is a waterbody of interest due to fecal coliform violations and the potential for removal of shellfish harvesting limitations. The purpose of these samples is to investigate the differences in existing water quality between the differing land uses that drain to Battery Creek.

In August 2012, sampling at existing water quality station Southside was discontinued. Sample collection was halted at this station due to the collection of at least three years of low-variability data, which is sufficient to establish the baseline existing water quality.

3.0 YEAR 5 DATA ANALYSIS

3.1 Year 5 Existing Water Quality

Stations with higher salinity values indicate the collection of tidally influenced samples rather than those of storm water resulting from a wet weather event. A small number sampling events at BECY-1, BECY-2, BECY-3, BECY-18, and BECY-19 indicate elevated salinity values. However, these events occur only during high tides in the region, such as those observed during the October and November 2012 events.

Sample stations with results above the applicable water quality standards should receive a higher priority for implementing future BMPs. Certain parameters are internally tracked for exceedances, which include biochemical oxygen demand, copper, dissolved oxygen, fecal coliform, pH, total phosphorus, and TKN. The established critical exceedance concentrations, as determined by Beaufort County, are based on the SCECAP standards, which are noted on the attached Tables for each specific parameter. During Year 5, all stations were observed to have average fecal coliform concentrations greater than the state shellfish harvesting standard of 14 CFU/100 ml. Copper was also detected at concentrations greater than the established critical exceedance

concentration. However, the copper exceedances were neither widespread nor consistent. Additionally, during Year 5, total phosphorus concentrations at sample station BECY-15 regularly exceeded the critical exceedance concentration of 0.98 milligrams per liter (mg/L). The observed concentrations will be closely monitored during Year 6.

Aside from these observations and typical seasonal fluctuations, sample stations in Year 5 did not experience widespread or routine results greater than the established critical exceedance concentrations.

As previously noted, GEL no longer collects a composite sample from the automatic sampler at sample location BECY-17. At this location the grab sample from the automatic sampler is collected, along with a second grab sample directly from the waterbody at the time of sample pick-up. A preliminary analysis of the fecal coliform concentrations from this sampling protocol was conducted to determine if a correlation existed with the lapsed time between samples and the fecal coliform concentrations at individual stations. This analysis did not reveal any trends based on lapsed time between the samples and the fecal coliform concentrations. It is assumed that the fecal coliform concentrations are affected by a number of station-specific variables that may overshadow the time between sample collections. These variables may include soil types and infiltration rates for the different stations, the land use and waterbody from which a sample is collected (i.e., pond adjacent to a parking lot versus a high-flow drainage creek), and time of concentration. Results may also be influenced by the duration, intensity, and overall amount of rainfall that triggers a sample collection.

As noted above and in Section 1.2, a new sampling protocol was initiated at sample station BECY-9ra. A small set of samples have been collected at this sample station utilizing the new sampling protocol. As such, a thorough analysis could not be conducted. However, a preliminary review of the data did not indicate obvious trends between parameter concentrations and the lapsed time between the initial grab sample and a longer duration (up to 16 hours) composite sample.

Lastly, extremely elevated DO concentrations were observed in December 2011, and other times throughout Year 5. These values indicate supersaturation of oxygen and are unexpected given site and climatic conditions. Based on a review of this data, it appears the DO concentrations may be an anomaly caused by an error with field equipment (i.e. calibration drift).

4.0 2007-2012 WATER QUALITY MONITORING PROGRAM REVIEW

Five years of water quality data have been collected and as such, Beaufort County requested a more thorough review of the data and an overall evaluation of the WQMP. As part of this effort, the County contracted with Mr. Rich Wagner of CDM Smith to

review the data with respect to the goals of the monitoring program as stated in the 2006 SWMP, which was also completed by CDM Smith. A copy of Mr. Wagner's report, *Beaufort County Monitoring Program Review*, dated December 4, 2012, is provided as Appendix I. This report, as well as follow-up communications with Mr. Wagner, were used to complete Sections 4.1 through 4.3 of this report.

4.1 2007 – 2012 Water Quality Data Evaluation

As previously indicated, two of the primary goals of the County's WQMP are: 1) establish and evaluate baseline existing water quality and, 2) track long-term trends to evaluate BMP effectiveness.

The purpose of the existing water quality sample stations is to establish baseline water quality in developed areas where the SWMP suggested water quality controls would be effective in improving water quality. To determine the effectiveness of a future water quality control retrofit, the existing water quality has to be established for comparison to the water quality after the retrofit. Importantly, if no retrofit is established, the collected data only served to establish the water quality during the sampling of that station. Based on CDM Smiths's review of the existing water quality data, it appears that 3-4 years of data is sufficient to establish the existing water quality. After the collection of 3-4 years of data, these sample stations can be discontinued or relocated to another location.

As part of the WQMP review, the data was evaluated to determine the quality of the water at the sample stations. Given the dataset as a whole, the results indicate "good" water quality. This indication of "good" water quality is based upon a lack of chronic or routine critical exceedance concentrations in sample results. Some stations, such as Southside, have concentrations of certain parameters (nitrogen species, phosphorus, chlorophyll-a, dissolved oxygen) that are higher in comparison to the other sample stations. However, these results are in comparison to the other sample stations, and it is important to note that the observed concentrations did not routinely exceed the 'critical exceedance concentrations.

The second type of data collected as part of the WQMP is to track long-term trends to evaluate BMP effectiveness. Typically, to make a full evaluation of the water quality for a long-term trend analysis, at least 10 years of data is necessary. However, a preliminary analysis was completed to determine if any statistically significant trends can be observed. The review indicates that very few significant trends were observed during the five years of collected data, which indicates that little significant change has occurred in the water quality at each station. However, very little development has occurred between 2007 and 2012 due to the economic downturn. Therefore, the lack of trends in water quality may be expected. It will be important to continue monitoring the trends stations as development increases to determine whether water

quality is impacted.

One observed trend is increasing concentrations for ammonia and TKN at sample stations BECY-1, BECY-2, and BECY-3. Interestingly, the increasing concentrations are a result of several high measurements in Year 5. If the trend analysis at these stations did not include data from Year 5, no significant trends would have been observed. The observed concentrations did not exceed the critical exceedance concentration values, but it will be important to closely monitor these sample stations to observe if the increasing trend continues.

Beaufort County also inquired if any correlation could be observed between water quality data and rainfall/droughts in the region. Mr. Wagner indicated that annual rainfall amounts could be characterized as above average ("wet year"), below average ("dry year"), or at the average rainfall amount. The water quality data for these three classifications of rainfall could be pooled, and an analysis could compare the means and distribution of these data. However, it was determined that performing this evaluation would not likely yield significant results for discussion.

4.2 Water Quality Monitoring Program Recommendations

The WQMP was reviewed in respect to the four primary goals, as identified in the 2006 SWMP. The purpose of this review was to establish recommendations for future monitoring in respect to these goals.

4.2.1 Trend Monitoring Analysis

As noted above, the preliminary analysis of the tracking long-term trends for BMP efficiencies did not indicate widespread trends toward increasing or decreasing water quality. However, little change in land use has occurred, so these results are not unexpected. It is recommended to continue monitoring these sample stations to effectively evaluate the long-term trends, especially as land use change increases.

4.2.2 Existing Water Quality Monitoring Analysis

To reiterate, the purpose of the existing water quality analysis is to establish the baseline water quality in developed areas where the SWMP suggested water quality controls would be effective in improving the water quality. The analysis revealed that three to four years of data is sufficient to establish the baseline water quality, and then the sample station can be discontinued or relocated to another site. It is recommended to continue monitoring the existing water quality stations to establish baseline water quality, especially in developed areas that may benefit from a future water quality control retrofit.

4.2.3 Efficiency of Best Management Practice Monitoring Analysis

The third monitoring goal identified in the SWMP includes the collection of data to

measure the efficiency of existing BMPs. The purpose of this data is to validate the pollutant removal efficiency estimates used in the SWMP. As a whole, the sampling of BMPs tends to be difficult and expensive to correctly conduct. These evaluations require the collect of automatic volume-composited samples of all inflows and outflows. The BMP sampling conducted at the Eagles Pointe Golf Club (Eagles Pointe) BMP (pond system) demonstrates this difficulty of measuring its efficiency (i.e. multiple inflow sources and outflow locations). It should be noted the data collected from the Eagles Point BMP demonstrated that the use of this type of BMP (pond system) is effective at reducing levels of specific testing groups.

The existing literature on effectiveness of BMPs (such as ponds) is abundant and would likely suffice to justify the values used in the SWMP. Therefore, traditional BMP sampling should be a lower priority for future monitoring efforts.

4.2.4 Single Land use Monitoring Analysis

The fourth monitoring goal identified in the SWMP is the collection of runoff data from single land use areas, such as industrial and high-density residential development. The purpose is to compare the observed concentrations to those used in the SWMP. To date, the WQMP has collected the least amount of data from single land use areas. However, as with BMP sampling, there is a significant amount of literature on single land use sampling to justify the values used in the SWMP.

The types of data presented in literature are typically based on sample collections triggered by a large rain event (at least 0.5 inches), rather than the smaller event (0.1 inches) used in the WQMP. The larger rainfall event is used to ensure an adequate amount of runoff is captured from these single land use areas. Sampling runoff from a small rainfall event may result in lower average concentrations than those used in the SWMP, as has been observed in the County's WQMP.

If single land use sampling is deemed a future priority by the County, new sample stations could be established and a higher rainfall amount could be utilized at these locations to trigger a sampling event. However, the increase in the rainfall trigger from 0.1 inches to 0.5 inches would likely lead to the collection of fewer samples.

4.2.5 Other Recommendations

The WQMP review also included an assessment to determine if any parameters could be dropped from the monitoring. Most of the parameters currently included in the program are important to assess overall water quality. Additionally, most of these parameters are detected at concentrations greater than the laboratories minimal detection limit, which indicates they are present in the waterbody, albeit at concentrations typically below the critical exceedance concentrations. However, several metals are rarely detected in the water samples; thus an assessment was

conducted to determine if dropping those metals from the monitoring would result in any cost savings.
It was determined that a small cost savings could be incurred if the number of metals analyzed was less than four. By analyzing only three metals (those regularly detected), there would be a cost savings of approximately $10 per sample. Currently, 52 samples are collected annually for metals analysis, which would equate to a $520 savings per year by analyzing for only three metals. As development increases, water quality could be impacted and the previously undetected metals could increase in concentrations. Based on this and the relatively small cost savings, it is recommended to continue monitoring for the full suite of metals.

4.3 Future Challenges of the Water Quality Monitoring Program

With changing requirements, the water quality monitoring program will also need adjustment in order to evaluate these changes. One example is the County's addition of runoff volume control requirements. Moving forward, it will be useful to monitor a volume control BMP, such as bioretention (i.e. rain garden) as one becomes available to evaluate its effectiveness. To monitor a rain garden, key data collection would include a continuous rainfall gage, continuous stage measurements in the rain garden (when ponding occurs), and automatic water quality sampling when significant ponding occurs.

Typically, a rain garden will have a small, highly impervious tributary area, such as a parking lot, that will allow the volume of runoff inflow to be estimated based on the rainfall amount. However, if the rain garden has a single inflow location, this point can be monitored and accurately measured. Additionally, the overflow of the rain garden should also be directly measured or estimated (i.e. if a weir is present, calculate the overflow based on a standard weir equation and water depth). The overall objective would be to determine in the long-term, how much (percentage) of the runoff is captured by the rain garden, and also estimate the typical runoff concentrations captured in the rain garden.

5.0 CONCLUSIONS AND RECOMMENDATIONS

GEL was retained to continue the WQMP during year 2011-2012, while integrating improvements over the existing sampling and analysis program. The following was observed during the summary of Year 5 (2011-2012):

- The average concentrations of fecal coliform exceed the state shellfish harvesting waters standard of 14 CFU/100 mL at all sample stations.
- Sampling at one sample station, Southside, was discontinued due to the collection of at least three years of consistent baseline water quality data.
- Two sample stations, BECY-18 and BECY-19, were added in order to compare the baseline water quality data between sample stations that drain into Battery Creek

from a mostly undeveloped area (BECY-18) and a mostly developed area (BECY-19).

- The total phosphorus concentrations observed at sample station BECY-15 regularly exceeded the established critical exceedance concentration during Year 5.
- The remaining data collected in Year 5 did not regularly exceed action levels for parameters with "critical exceedance concentrations".

Additionally, CDM Smith and GEL reviewed the WQMP since its inception (2007-2012). The following observations are drawn from this review:

- Given the dataset as a whole, the results signify 'good' water quality, as indicated by a lack of chronic or routine critical concentration exceedances. Some stations have concentrations of certain parameters that are higher in comparison to other stations, but these concentrations are typically below critical exceedance concentrations.
- Increasing trends for ammonia and TKN were observed at BECY-1, BECY-2, and BECY-3. The increasing trend is due to several high concentrations observed during Year 5; although, the concentrations are below the critical exceedance concentrations.
- Aside from the above-listed trend, no other significant trends were observed for the five years of collected data, which indicates little change in the overall water quality at these stations between 2007 and 2012.

Lastly, CDM Smith and GEL have reviewed the WQMP in regards to the four primary goals identified in the SWMP. The following recommendations have been made in respect to these goals:

- Continue monitoring at long-term trend analysis stations. At least 10 years of data is needed to effectively monitor the presence of long-term trends.
- Continue monitoring existing water quality stations to establish baseline water quality, especially in developed areas that may benefit from a future water quality control retrofit.
- Results from monitoring the Eagles Pointe BMP (pond system) demonstrate its effectiveness of reducing levels of specific testing groups. However, due to the difficulty and expense of collecting data to measure the actual efficiency of a BMP, as well as the amount of literature available that documents BMP efficiency, traditional BMP monitoring should be a lower priority for future monitoring efforts.
- A large amount of literature and data also exists to estimate the runoff concentrations from single land use areas (i.e. high density residential);

therefore, monitoring of runoff from single land use areas should be a lower priority for future monitoring efforts.

- Continue monitoring the existing list of parameters, which will allow for effective monitoring of the overall quality of surface water and long-term trends in Beaufort County.

6.0 REFERENCES

Beaufort County Storm Water Management Plan, February 20, 2006, Thomas & Hutton Engineering Co. and Camp Dresser McKee Inc.

Beaufort County Monitoring Program Review, March 24, 2008, Camp Dresser and McKee Inc.

Beaufort County Monitoring Program Review, December 4, 2012, CDM Smith.

South Carolina Department of Health and Environmental Control, April 25, 2008, Water Classifications and Standards Regulation 61-68: Bureau of Water.

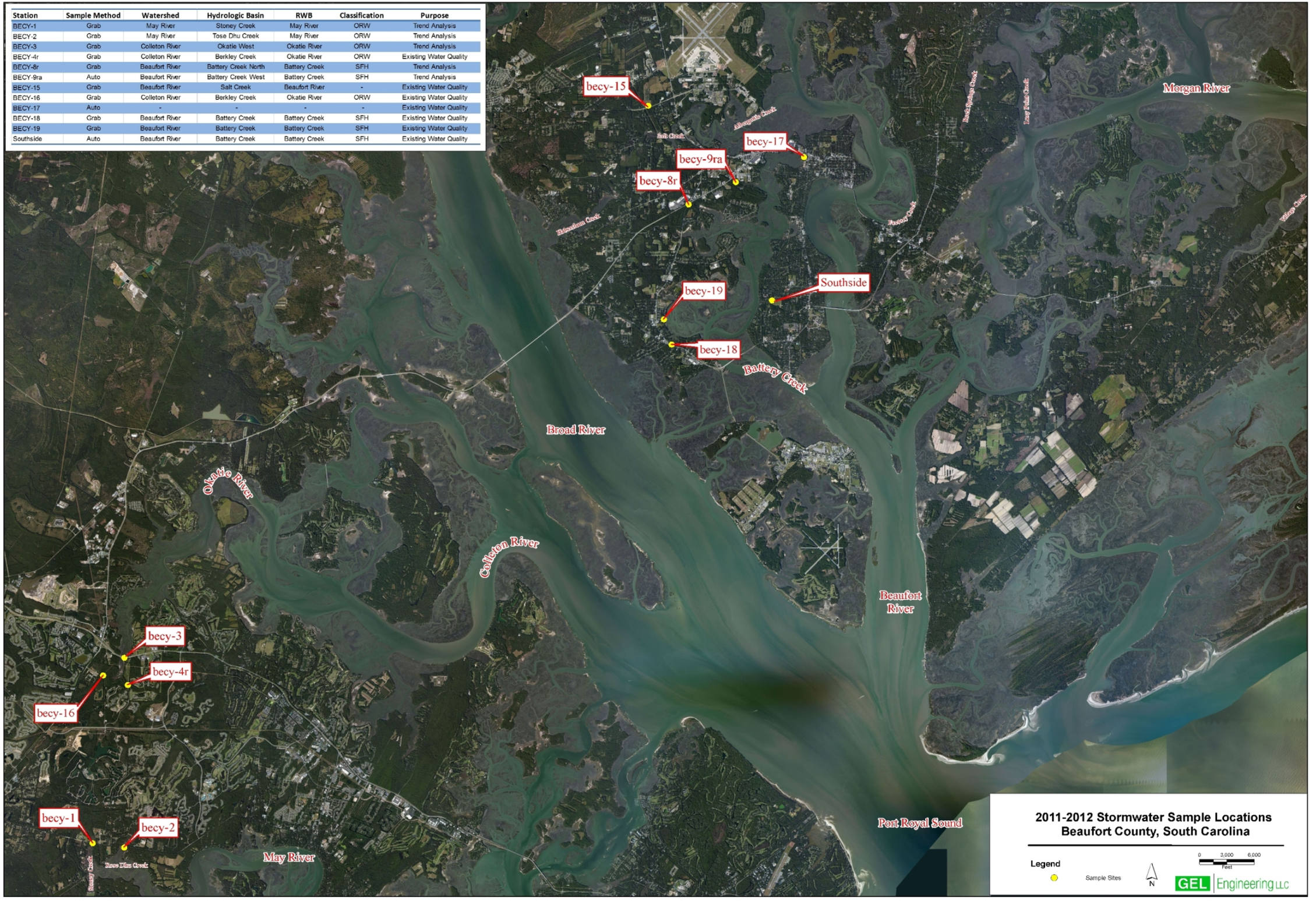
South Carolina Department of Health and Environmental Control, Shellfish Sanitation Program Water Monitoring, Assessment and Protection Division, Environmental Quality Control-Bureau of Water, Annual Update, July 2006, Update.

USEPA, 2005. Microbial Source Tracking Guide Document. Office of Research and Development, Washington, DC, EPA/600/R-05/064.

USEPA, 2006, Water Quality Standards Database.

FIGURE

Station	Sample Method	Watershed	Hydrologic Basin	RWB	Classification	Purpose
BECY-1	Grab	May River	Stoney Creek	May River	ORW	Trend Analysis
BECY-2	Grab	May River	Tose Dhu Creek	May River	ORW	Trend Analysis
BECY-3	Grab	Colleton River	Okatie West	Okatie River	ORW	Trend Analysis
BECY-4r	Grab	Colleton River	Berkley Creek	Okatie River	ORW	Existing Water Quality
BECY-8r	Grab	Beaufort River	Battery Creek North	Battery Creek	SFH	Trend Analysis
BECY-9ra	Auto	Beaufort River	Battery Creek West	Battery Creek	SFH	Trend Analysis
BECY-15	Grab	Beaufort River	Salt Creek	Beaufort River	-	Existing Water Quality
BECY-16	Grab	Colleton River	Berkley Creek	Okatie River	ORW	Existing Water Quality
BECY-17	Auto	-	-	-	-	Existing Water Quality
BECY-18	Grab	Beaufort River	Battery Creek	Battery Creek	SFH	Existing Water Quality
BECY-19	Grab	Beaufort River	Battery Creek	Battery Creek	SFH	Existing Water Quality
Southside	Auto	Beaufort River	Battery Creek	Battery Creek	SFH	Existing Water Quality



TABLES

Table 1
Recommended Tributary Sample Locations

Watershed	Hydrologic Basin	% Urban - Future Land Use	% Impervious - Future Land Use	Future Increase in % Urban	Future Increase in % Impervious	Sampling Method	Purpose
Beaufort River	Southside	92%	51%	2%	1%	Automatic	High Density Residential Runoff
Beaufort River	Albergotti Creek	93%	67%	0%	0%	Automatic	Industrial Runoff
Colleton River	Camp St. Marys	48%	8%	16%	2%	Automatic	Low Density Residential Runoff
Morgan River	Rock Springs Creek	96%	22%	7%	2%	Automatic	Medium Density Residential Runoff
Beaufort River	Burton Hill	71%	43%	19%	13%	Grab	Existing Quality[1]
Beaufort River	Grober Hill	53%	25%	12%	3%	Grab	Existing Quality[1]
Beaufort River	Salt Creek	75%	27%	35%	13%	Grab	Existing Quality
Beaufort River	Salt Creek South	78%	30%	41%	11%	Grab	Existing Quality[1]
Beaufort River	Shanklin Road	81%	49%	31%	21%	Grab	Existing Quality[1]
Colleton River	Berkeley Creek	67%	18%	15%	5%	Grab	Existing Quality
Morgan River	Factory Creek	84%	25%	15%	5%	Grab	Existing Quality[1]
Morgan River	Lucy Point	95%	21%	6%	1%	Grab	Existing Quality
Beaufort River	Battery Creek North	90%	67%	55%	43%	Grab	Trend Analysis[1]
Beaufort River	Battery Creek West	82%	28%	50%	10%	Grab	Trend Analysis[1]
Colleton River	Okatie West	83%	25%	58%	19%	Grab	Trend Analysis
May River	Rose Dhu Creek	91%	22%	54%	13%	Grab	Trend Analysis
May River	Stoney Creek	72%	12%	51%	8%	Grab	Trend Analysis
Morgan River	Coffin Creek	87%	22%	59%	14%	Grab	Trend Analysis

[1] Sampling station is downstream of potential regional detention site, and therefore may provide data for prioritizing the construction of ponds and evaluating benefits (if pond is built)

[2] Location was inadvertently listed as "Coffin Creek" in the Beaufort County Stormwater Master Plan, Thomas & Hutton and CDM, 2006.

Table 2
Revised Tributary Sample Locations

Station	Sample Meth	Watershed	Hydrologic Basin	RWB	Classification	Purpose
BECY-1	Grab	May River	Stoney Creek	May River	Outstanding Resource Waters	Trend Analysis
BECY-2	Grab	May River	Tose Dhu Creek	May River	Outstanding Resource Waters	Trend Analysis
BECY-3	Grab	Colleton River	Okatie West	Okatie River	Outstanding Resource Waters	Trend Analysis
BECY-4r	Grab	Colleton River	Okatie East	Okatie River	Outstanding Resource Waters	Existing Water Quality
BECY-8r	Grab	Beaufort River	Battery Creek North	Battery Creek	Shellfish Harvesting	Trend Analysis
BECY-9ra	Auto	Beaufort River	Battery Creek West	Battery Creek	Shellfish Harvesting	Trend Analysis
BECY-15	Grab	Beaufort River	Salt Creek	Beaufort River	Class SA	Existing Water Quality
BECY-16	Grab	Colleton River	Okatie West	Okatie River	Outstanding Resource Waters	Existing Water Quality
BECY-17a	Auto	Beaufort River	Battery Creek West	Battery Creek	N/A	Existing Water Quality
BECY-18	Grab	Beaufort River	Battery Creek	Battery Creek	Shellfish Harvesting	Existing Water Quality
BECY-19	Grab	Beaufort River	Battery Creek	Battery Creek	Shellfish Harvesting	Existing Water Quality
Southside	Auto	-	-	-	-	Existing Water Quality

Table 3

Year 5 Data Summary - Ammonia-Nitrogen (NH3)

Station	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	May-12	Jul-12	Aug-12	Aug-12	Sep-12	Oct-12	Oct-12	Nov-12
	11/17/2011	12/15/2011	1/12/2012	2/28/2012	3/14/2012	4/6/2012	5/7/2012	5/15/2012	7/30/2012	8/6/2012	8/29/2012	9/19/2012	10/1/2012	10/9/2012	11/16/2012
BECY-9ra Grab After	0.053		0.085		0.120										
BECY-9ra Grab	0.155		0.130		0.113	0.083	0.603			0.080	0.282	0.310	0.255	0.118	0.174
BECY-9ra Comp						0.154	0.731			0.310	0.294	0.265	0.234	0.223	0.218
Southside Grab After	1.360		0.476		0.260		0.660	1.350	0.140						
Southside Grab	0.424		0.612		0.627		1.450	1.320	0.345						
BECY-17a After	0.042		0.144		0.189	0.349	0.362	0.769	0.745	1.140	0.096	0.171	0.284	0.399	
BECY-17a Grab	0.137		0.116		0.131	1.210	0.402	0.804	0.196	0.819	0.103	0.303	0.164	0.138	
BECY-1	0.561	0.098	0.150	0.171		0.122		0.567	1.100	0.904	0.359	0.786	0.274	0.220	0.112
BECY-2	0.222	0.021	0.064	0.028		0.114		0.511	0.370	0.340	0.197	0.375	0.198	0.222	0.118
BECY-3	0.429	0.066	0.150	0.273		0.106		0.475	0.272	0.200	0.251	0.348	0.196	0.312	0.171
BECY-4r	0.083	0.036	0.183	0.016		0.445		0.266	0.334	0.254	0.155	0.359	0.193	0.182	0.270
BECY-8r	0.083	0.032	0.148	0.092	0.195	0.155		0.263	0.228	0.319	0.158	0.225	0.295	0.214	0.775
BECY-15	0.108	0.098	0.252	0.214	0.268	0.294		0.492			0.386	0.658	0.565	0.412	0.271
BECY-16	0.131	0.066	0.120	0.182		0.326		0.291	0.174	0.294	0.188	0.169	0.187	0.204	0.147
BECY-18										0.338	0.573	0.366	0.413	0.428	0.239
BECY-19										0.254	0.209	0.378	0.323	0.256	0.284

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 4

Year 5 Data Summary - Biochemical Oxygen Demand* (BOD5)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	1.59		1.17		1.83										
BECY-9ra Grab	3.16		2.43		2.66	2.04	4.35			1.74	4.01	3.11	5.42	7.62	3.11
BECY-9ra Comp						2.03	5.93			4.48	4.98	1.79	2.51	4.19	2.06
Southside Grab After	5.46		4.60		2.37		6.34	4.85	5.65						
Southside Grab	2.42		5.29		5.10		3.93	6.24	6.19						
BECY-17a After	5.81		5.00		8.68		4.01	2.46	6.31	3.88	2.73	5.17	3.99	4.98	
BECY-17a Grab	10.90		3.82		8.88	4.65	3.81	3.83	5.50	5.22	1.31	8.01	3.37	3.66	
BECY-1	6.53	1.88	1.63	1.96		2.48		1.87	3.72	1.96	2.47	1.92	1.81	2.95	1.42
BECY-2	1.89	1.97	1.00	1.78		1.16		2.50	1.81	1.08	1.60	1.02	1.00	2.14	1.53
BECY-3	1.00	1.43	1.34	1.92		1.00		3.78	1.12	1.40	1.51	1.77	1.43	3.71	1.47
BECY-4r	11.50	1.69	1.24	2.89		2.20		3.66	4.19	2.41	2.39	1.00	1.72	2.10	3.51
BECY-8r	2.85	1.39	2.79	3.52	2.49	9.46		2.58	4.47	2.89	1.94	1.77	2.90	2.95	2.86
BECY-15	4.51	1.15	3.19	2.19	1.00	3.62		2.17			3.14	4.75	5.35	4.03	4.55
BECY-16	3.11	1.80	1.70	2.67		3.37		2.38	2.84	2.87	3.25	1.00	2.25	1.99	3.05
BECY-18										2.59	1.62	1.96	2.66	5.81	3.30
BECY-19										1.39	1.21	1.15	1.00	1.81	1.58

*Biochemical Oxygen Demand is internally tracked for Critical Exceedances Concentration Information. Values greater than 56.0 mg/L are reported monthly to Beaufort County.

Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 5

Year 5 Data Summary - Cadmium (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	0.11				0.11										
BECY-9ra Grab	0.11				0.11						0.11				
BECY-9ra Comp											0.11				
Southside Grab After	0.11				0.11			0.11							
Southside Grab	0.11				0.15			0.11							
BECY-17a After	0.11				0.11			0.11			0.129				
BECY-17a Grab	0.308				0.519						7.98				
BECY-1	0.11			0.11				0.11			0.11				
BECY-2	0.11			0.11				0.11			0.11				
BECY-3	0.11			0.11				0.11			0.55				
BECY-4r	0.11			0.11				0.11			0.11				
BECY-8r	0.11			0.11				0.11			0.11				
BECY-15	0.11			0.11				0.11			0.11				
BECY-16	0.11			0.11				0.11			0.11				
BECY-18											0.11				
BECY-19											0.11				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 6

Year 5 Data Summary - Chlorophyll-a

Station	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	May-12	Jul-12	Aug-12	Aug-12	Sep-12	Oct-12	Oct-12	Nov-12
	11/17/2011	12/15/2011	1/12/2012	2/28/2012	3/14/2012	4/6/2012	5/7/2012	5/15/2012	7/30/2012	8/6/2012	8/29/2012	9/19/2012	10/1/2012	10/9/2012	11/16/2012
BECY-9ra Grab After	8.7		11.0		0.7										
BECY-9ra Grab	4.5		13.8		5.8	2.6	14.2			1.7	25.4	2.5	1.8	2.2	22.3
BECY-9ra Comp						3.5	2.0			8.7	2.9	0.5	0.2	0.9	9.4
Southside Grab After	7.5		9.9		27.9		33.5	16.2	0.3						
Southside Grab	5.7		3.5		27.1		13.5	3.7	3.8						
BECY-17a After	1.5		3.7		0.4	0.4	1.1	1.9	3.0	0.9	3.0	2.9	3.1	2.9	
BECY-17a Grab	0.8		0.7		0.5	2.4	0.5	0.7	3.7	2.6		1.3	0.6	1.5	
BECY-1	7.0	10.4	11.7	3.6		13.5		15.3	17.6	18.9	4.4	26.3	19.1	4.2	2.6
BECY-2	7.2	8.6	4.0	8.4		5.8		30.0	8.9	14.7	16.4	6.0	4.3	5.3	2.6
BECY-3	6.3	5.4	11.7	6.5		3.5		18.2	12.7	15.7	11.3	35.4	16.9	27.2	3.3
BECY-4r	0.7	5.2	5.6	7.5		0.5		31.1	16.6	8.0	15.5	1.4	14.7	16.6	0.6
BECY-8r	14.2	17.0	9.6	4.9	2.5	5.8		3.5	5.2	9.7	7.1	0.5	4.3	2.2	1.4
BECY-15	1.9	0.7	0.8	1.7	2.5	2.7		1.7			2.6	0.9	4.1	0.7	4.2
BECY-16	3.2	10.7	6.5	13.1		6.3		19.3	3.4	20.3	11.7	7.3	17.2	6.1	5.0
BECY-18										2.2	0.9	2.7	5.2	8.5	5.7
BECY-19										7.4	2.8	1.8	4.3	0.3	3.1

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in μg/L

Table 7

Year 5 Data Summary - Chromium (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	2.0				2.0										
BECY-9ra Grab	2.0				2.0						3.8				
BECY-9ra Comp											4.4				
Southside Grab After	2.0				2.0			2.0							
Southside Grab	2.0				2.0			2.0							
BECY-17a After	2.0				2.0			2.0			2.0				
BECY-17a Grab	2.0				2.0			2.0			2.0				
BECY-1	2.0			2.0				2.0			2.0				
BECY-2	2.0			2.0				2.0			2.0				
BECY-3	2.0			2.0				2.0			2.0				
BECY-4r	3.4			2.0				2.0			2.0				
BECY-8r	2.0			2.0				2.0			2.0				
BECY-15	2.0			2.0				2.0			2.0				
BECY-16	2.0			2.0				2.0			2.0				
BECY-18											2.0				
BECY-19											2.0				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 8

Year 5 Data Summary - Conductivity

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	261		208		130					516.50					
BECY-9ra Grab	571		96		149	146	4350				**	127	121	301	10563
BECY-9ra Comp						170	8915			4036	**	756	368	257	34807
Southside Grab After	16076		13400		564		1690	3381	46						
Southside Grab	1512		17032		2293		40726	3450	142						
BECY-17a After	39		56		38	3	195	712	57	2765	**	56	122	191	
BECY-17a Grab	70		40		31	57	494	800	63	1658	**	762	31	26	
BECY-1	9546	34778	38834	604		36537		**	26800	35115	**	13573	31943	416	42677
BECY-2	32107	39380	40602	3313		30455		**	20270	32914	**	30324	37701	1362	42112
BECY-3	23528	29961	41701	3514		5436		6492	498	20669	**	35172	34980	2392	43969
BECY-4r	472	588	761	166		893		412	245	857	**	705	668	119	11152
BECY-8r	624	193	424	194	176	168		812	1086	361	**	321	337	105	6922
BECY-15	171	182	257	202	124	115		133			71	133	118	98	146
BECY-16	180	850	911	145		791		**	833	1007	**	348	787	127	2447
BECY-18										19106	**	10145	38526	2067	42306
BECY-19										12543	**	268	182	143	21977

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µS/cm

** Field Instrument Malfunction

Table 9

Year 5 Data Summary - Copper*

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	2.04				2.95										
BECY-9ra Grab	0.89				1.48						**5.32**				
BECY-9ra Comp											3.74				
Southside Grab After	4.73				1.77			1.79							
Southside Grab	5.65				2.27			2.81							
BECY-17a Grab After	4.09				4.79			2.32			2.04				
BECY-17a Grab	**6.3**				5.37			2.31			2.3				
BECY-1	**5.97**			0.82				3.89			1.71				
BECY-2	**10.70**			3.37				4.78			2.39				
BECY-3	**7.28**			2.20				3.17			2.84				
BECY-4r	1.39			1.32				1.43			1.55				
BECY-8r	2.61			2.14				**69.90**			1.61				
BECY-15	4.21			0.753				2.41			3.45				
BECY-16	11.4			1.84				2.25			1.89				
BECY-18											2.89				
BECY-19											3.82				

*Copper is internally tracked for Critical Exceedances Concentration Information. Values greater than 5.0 ug/L are reported monthly to Beaufort County.

BOLD = Concentration exceeds the Critical Exceedance Concentration.

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 10

Year 5 Data Summary - Dissolved Oxygen* (DO)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	6.5		7.7		4.9										
BECY-9ra Grab	7.5		8.2		3.4	4.6	8.4			9.5	**	4.4	5.6	5.4	10.8
BECY-9ra Comp						3.9	7.2			11.5	**	7.6	3.0	5.2	12.1
Southside Grab After	7.0		6.7		4.5		6.7	**1.6**	7.3						
Southside Grab	6.4		16.1		5.3		5.8	**2.8**	6.4						
BECY-17a After	3.0		**2.1**		**1.8**	**2.5**	6.7	7.1	6.1	3.8	**	**2.2**	**1.8**	3.0	
BECY-17a Grab	4.1		4.8		**2.3**	3.2	11.2	5.9	8.0	3.9	**	5.3	**2.4**	3.1	
BECY-1	5.0	16.4	11.7	15.7		5.3		**	3.5	6.1	**	6.9	16.6	9.1	10.6
BECY-2	13.8	21.2	8.9	15.9		9.6		**	6.0	7.6	**	10.0	7.9	11.1	11.1
BECY-3	8.7	23.2	14.3	14.8		14.6		7.3	6.3	13.5	**	9.4	7.8	8.1	9.9
BECY-4r	17.8	26.4	17.1	12.7		10.7		8.8	5.3	8.4	**	11.6	22.2	11.2	12.1
BECY-8r	7.2	8.6	7.1	5.8	4.7	3.6		4.2	8.9	7.0	**	5.9	3.6	**2.9**	13.2
BECY-15	5.4	11.4	7.2	7.5	8.1	4.9		6.2			4.3	3.9	3.1	4.3	5.0
BECY-16	12.2	22.1	15.7	8.6		12.3		**	5.9	13.1	**	10.8	11.8	5.2	9.7
BECY-18										6.5	**	11.9	4.7	4.6	9.7
BECY-19										7.1	**	6.4	3.1	5.0	11.3

*Dissolved Oxygen is internally tracked for Critical Exceedances Concentration Information. Values less than 3.0 are reported monthly to Beaufort County.
Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.
BOLD = Concentration exceeds the Critical Exceedance Concentration.
'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler
Sampling Discontinued at Station Southside (August 2012)
Sampling at Stations BECY-18 and BECY-19 added in August 2012
** DO field instrument malfunction
Results reported in mg/L

Table 11

Year 5 Data Summary - Fecal Coliform*

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	**16000**		**16000**		**1700**		**3000**			**2382**	**3873**	**948**	**908**	**1515**	**520**
BECY-9ra Grab	**>16000**		**9000**		**1300**	**800**	**3000**			**1211**	**3076**	**18416**	**3873**	**>24196**	**40**
BECY-9ra Comp						**300**	**>16000**			**1043**	**11199**	**914**	**6131**	**24196**	**292**
Southside Grab After	**16000**		**500**		**1700**		**>16000**	**800**	**24196**						
Southside Grab	**230**		**2400**		**9000**		**1100**	**1300**	**19863**						
BECY-17a After	**5000**		**3000**		**700**	**1300**	**>16000**	**800**	**15531**	**216**	**7701**	**34658**	**39726**	**862**	
BECY-17a Grab	**>16000**		**9000**		**300**	**300**	**9000**	**500**	**8665**	**2098**	**3255**	**6896**	**>24196**	**>48392**	
BECY-1	**24000**	**500**	**260**	**700**		**210**		**1100**	**2064**	**512**	**1918**	**1236**	**1236**	**683**	**156**
BECY-2	**5000**	**230**	**230**	**800**		**220**		**1700**	**987**	**471**	**512**	**148**	**86**	**576**	**75**
BECY-3	**2800**	**300**	**300**	**1400**		**80**		**3000**	**269**	**63**	**1100**	**98**	**417**	**805**	**97**
BECY-4r	**500**	**1100**	**2400**	**1300**		**500**		**1700**	**2382**	**279**	**2481**	**610**	**5475**	**1226**	**1336**
BECY-8r	**300**	**400**	**13000**	<20	**3000**	**3000**		**7000**	**16328**	**6510**	**2086**	**24066**	**22398**	**1434**	**7746**
BECY-15	**5000**	**2200**	**220**	**1700**	**2400**	**2200**		**1700**			**3255**	**1382**	**1968**	**5475**	**5475**
BECY-16	**1300**	**1400**	**1400**	**800**		**1400**		**2200**	**932**	**670**	**613**	**201**	**1989**	**292**	**733**
BECY-18										**19863**	**5475**	**3000**	**4106**	**9208**	**233**
BECY-19										**2613**	**794**	**269**	**305**	**441**	**631**

*Fecal Coliform is internally tracked for Critical Exceedances Concentration Information. Values greater than 14 CFU/100 mL are reported monthly to Beaufort County.

BOLD = Concentration exceeds the Critical Exceedance Concentration.

Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in Colony Forming Units (CFU)/100 mL

Table 12

Year 5 Data Summary - Iron (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	1290				730										
BECY-9ra Grab	849				1140						3520				
BECY-9ra Comp											3650				
Southside Grab After	646				813			936							
Southside Grab	959				1120			1330							
BECY-17a After	107				73			163			83				
BECY-17a Grab	88				83			146			95				
BECY-1	2330			2010				2290			2040				
BECY-2	1220			1900				2070			1200				
BECY-3	1630			1330				1450			1340				
BECY-4r	4970			1100				1670			1210				
BECY-8r	898			388				855			474				
BECY-15	2960			2680				2150			1340				
BECY-16	1040			1050				820			1080				
BECY-18											1300				
BECY-19											1250				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 13

Year 5 Data Summary - Lead (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	0.96				0.50										
BECY-9ra Grab	0.50				0.50						3.93				
BECY-9ra Comp											4.61				
Southside Grab After	0.92				0.50			0.50							
Southside Grab	0.50				0.55			0.73							
BECY-17a After	0.68				0.50			0.64			0.50				
BECY-17a Grab	0.78				0.50			0.50			0.63				
BECY-1	1.15			0.82				0.85			1.47				
BECY-2	0.50			0.54				0.56			0.50				
BECY-3	0.50			0.67				0.88			0.83				
BECY-4r	0.91			0.62				0.56			0.88				
BECY-8r	0.50			0.50				0.50			0.50				
BECY-15	1.33			0.54				1.07			1.19				
BECY-16	0.62			0.50				0.50			0.50				
BECY-18											1.46				
BECY-19											0.50				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 14

Year 5 Data Summary - Manganese (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	100.0				89.3										
BECY-9ra Grab	88.3				24.5						30.0				
BECY-9ra Comp											58.3				
Southside Grab After	34.3				60.0			56.3							
Southside Grab	46.7				60.9			65.0							
BECY-17a After	17.2				27.7			18.9			14.9				
BECY-17a Grab	28.4				19.7			22.9			5.6				
BECY-1	511.0			80.8				921.0			114.0				
BECY-2	172.0			78.6				118.0			48.7				
BECY-3	340.0			109.0				159.0			106.0				
BECY-4r	1230.0			34.3				107.0			37.4				
BECY-8r	31.7			14.2				47.7			16.9				
BECY-15	214.0			179.0				101.0			54.3				
BECY-16	57.7			57.7				39.9			40.1				
BECY-18											29.7				
BECY-19											18.6				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 15

Year 5 Data Summary - Mercury (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	0.066				0.066										
BECY-9ra Grab	0.066				0.066						0.067				
BECY-9ra Comp											0.067				
Southside Grab After	0.066				0.066			0.067							
Southside Grab	0.066				0.066			0.067							
BECY-17a After	0.066				0.066			0.067			0.067				
BECY-17a Grab	0.066				0.066			0.067			0.067				
BECY-1	0.066			0.060				0.067			0.067				
BECY-2	0.066			0.066				0.067			0.067				
BECY-3	0.066			0.066				0.067			0.067				
BECY-4r	0.066			0.066				0.067			0.067				
BECY-8r	0.066			0.066				0.067			0.067				
BECY-15	0.066			0.066				0.067			0.067				
BECY-16	0.066			0.066				0.067			0.067				
BECY-18											0.067				
BECY-19											0.067				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

Table 16
Year 5 Data Summary - Nickel (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	1.00				2.27										
BECY-9ra Grab	1.69				1.18						1.73				
BECY-9ra Comp											1.90				
Southside Grab After	2.03				1.14			2.31							
Southside Grab	10.9				1.72			3.75							
BECY-17a After	0.5				0.926			1.13			0.556				
BECY-17a Grab	1.08				1.03			1.08			1.16				
BECY-1	6.44			1.15				7.12			1.29				
BECY-2	16.70			2.33				4.01			2.01				
BECY-3	14.20			2.46				1.83			4.31				
BECY-4r	1.63			0.80				0.89			0.99				
BECY-8r	0.98			0.80				1.23			0.65				
BECY-15	3.24			0.874				1.15			0.984				
BECY-16	0.717			0.714				1.16			0.726				
BECY-18											2.02				
BECY-19											2.04				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler
Sampling Discontinued at Station Southside (August 2012)
Sampling at Stations BECY-18 and BECY-19 added in August 2012
Results reported in µg/L

Table 17

Year 5 Data Summary - Nitrate-Nitrite (NOx)

Station	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	May-12	Jul-12	Aug-12	Aug-12	Sep-12	Oct-12	Oct-12	Nov-12
	11/17/2011	12/15/2011	1/12/2012	2/28/2012	3/14/2012	4/6/2012	5/7/2012	5/15/2012	7/30/2012	8/6/2012	8/29/2012	9/19/2012	10/1/2012	10/9/2012	11/16/2012
BECY-9ra Grab After	0.386		0.010		0.010										
BECY-9ra Grab	0.441		0.076		0.010	0.085	0.262			0.196	0.384	0.162	0.208	0.139	0.109
BECY-9ra Comp						0.085	0.244			1.700	0.299	0.082	0.176	0.066	0.136
Southside Grab After	0.389		0.015		0.010		0.206	0.017	0.157						
Southside Grab	0.330		0.064		0.010		0.026	0.017	0.269						
BECY-17a After	1.180		0.010		0.010	0.310	0.145	0.265	0.221	0.017	0.055	0.034	0.028	0.017	
BECY-17a Grab	0.575		0.303		0.537	0.420	0.235	0.231	0.154	0.091	0.106	0.102	0.416	0.173	
BECY-1	0.209	0.010	0.010	0.010		0.085		0.089	0.085	0.017	0.266	0.049	0.017	0.017	0.085
BECY-2	0.224	0.010	0.010	0.010		0.085		0.204	0.055	0.017	0.035	0.018	0.017	0.030	0.085
BECY-3	0.316	0.010	0.010	0.010		0.085		0.085	0.085	0.085	0.025	0.019	0.017	0.049	0.085
BECY-4r	0.160	0.010	0.010	0.010		0.085		0.032	0.046	0.126	0.021	0.076	0.033	0.040	0.023
BECY-8r	0.439	0.010	0.015	0.010	0.020	0.017		0.027	0.024	0.087	0.046	0.064	0.047	0.030	0.102
BECY-15	0.263	0.010	0.010	0.050	0.011	0.085		0.069			0.032	0.018	0.050	0.017	0.017
BECY-16	0.254	0.010	0.030	0.010		0.229		0.087	0.283	0.635	0.056	0.146	0.032	0.044	0.028
BECY-18										0.347	0.318	0.201	0.043	0.262	0.023
BECY-19										0.213	0.073	0.157	0.201	0.252	0.115

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 18

Year 5 Data Summary - pH*

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	8.0		8.1		7.4										
BECY-9ra Grab	8.1		8.2		7.4	7.6	8.0			8.6	**	7.8	8.3	8.1	8.0
BECY-9ra Comp						7.7	7.8			7.8	**	7.8	8.3	8.0	8.1
Southside Grab After	7.3		7.5		7.2		8.2	7.5	7.3						
Southside Grab	7.6		7.6		7.2		7.5	7.5	7.4						
BECY-17a After	7.2		7.7		7.0	7.2	7.9	7.4	7.2	7.7	**	7.5	7.7	7.4	
BECY-17a Grab	7.5		8.2		7.3	7.4	8.2	7.5	8.3	7.6	**	7.9	7.9	7.5	
BECY-1	7.6	7.8	7.8	7.8		7.9		**	7.0	8.1	**	8.0	8.7	8.1	8.2
BECY-2	7.4	7.3	7.1	7.6		8.2		**	7.0	8.2	**	7.7	7.9	8.3	8.3
BECY-3	7.4	7.3	7.8	7.4		7.5		7.6	**6.7**	8.3	**	8.0	8.2	8.0	8.2
BECY-4r	7.6	8.2	8.3	7.6		8.0		7.9	7.6	8.5	**	8.4	8.7	8.1	7.7
BECY-8r	7.4	7.6	7.6	7.4	7.1	7.4		7.5	7.0	7.8	**	7.7	7.8	7.6	7.7
BECY-15	7.2	7.6	7.5	7.7	7.2	7.6		7.9			7.6	7.6	7.7	**6.7**	7.6
BECY-16	7.8	7.9	8.3	7.5		8.2		**	7.8	8.8	**	8.5	8.4	8.0	7.7
BECY-18										7.9	**	7.5	7.6	7.8	8.0
BECY-19										7.9	**	7.2	7.3	7.4	7.9

*pH is internally tracked for Critical Exceedances Concentration Information. Values less than 7.0 and greater than 9.0 are reported monthly to Beaufort County.
Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.
BOLD = Concentration exceeds the Critical Exceedance Concentration.
'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler
Sampling Discontinued at Station Southside (August 2012)
Sampling at Stations BECY-18 and BECY-19 added in August 2012
Results reported in pH Standard Units
** Field Instrument Malfunction

Table 19

Year 5 Data Summary - Phosphorus* (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	0.216		0.237		0.114										
BECY-9ra Grab	0.626		0.386		0.109	0.206	0.868			0.300	**1.090**	0.357	0.270	0.626	0.180
BECY-9ra Comp						0.126	0.964			0.610	0.708	0.296	0.230	**1.020**	0.260
Southside Grab After	0.790		0.957		0.455		0.675	0.785	0.636						
Southside Grab	0.367		0.736		**1.170**		0.627	0.817	0.438						
BECY-17a After	0.392		0.763		0.246	0.183	0.310	0.211	0.350	0.777	0.290	0.821	0.447	0.286	
BECY-17a Grab	0.584		0.223		0.206	0.269	0.404	0.247	0.208	0.425	0.274	0.624	0.293	0.205	
BECY-1	0.507	0.124	0.137	0.115		0.113		0.416	0.967	0.499	0.199	0.696	0.415	0.267	0.079
BECY-2	0.275	0.087	0.064	0.194		0.103		0.290	0.262	0.192	0.156	0.187	0.121	0.346	0.049
BECY-3	0.242	0.075	0.151	0.046		0.101		0.149	0.139	0.159	0.198	0.261	0.112	0.357	0.053
BECY-4r	0.422	0.087	0.182	0.058		0.198		**1.040**	0.358	0.383	0.084	0.263	0.191	0.157	0.073
BECY-8r	0.121	0.084	0.133	0.089	0.083	**1.150**		0.289	0.225	0.390	0.252	0.297	0.341	0.150	0.135
BECY-15	**1.020**	0.494	**2.330**	0.821	0.742	**8.700**		0.638			0.510	**2.100**	**2.400**	**1.080**	**1.870**
BECY-16	0.115	0.081	0.122	0.087		0.114		0.088	0.120	0.190	0.262	0.163	0.203	0.118	0.063
BECY-18										0.311	0.525	0.331	0.182	0.591	0.136
BECY-19										0.210	0.188	0.207	0.208	0.118	0.136

*Phosphorus is internally tracked for Critical Exceedances Concentration Information. Values greater than 0.98 mg/L are reported monthly to Beaufort County.
Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.
BOLD = Concentration exceeds the Critical Exceedance Concentration.
'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler
Sampling Discontinued at Station Southside (August 2012)
Sampling at Stations BECY-18 and BECY-19 added in August 2012
Results reported in mg/L

Table 20

Year 5 Data Summary - Salinity

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	1.0		1.0		1.0	1.0									
BECY-9ra Grab	1.0		1.0		1.0	1.0	7.2			1.0	1.0	1.0	1.0	1.0	22.2
BECY-9ra Comp							2.5			1.7	1.0	1.0	1.0	1.0	22.1
Southside Grab After	1.0		9.4		1.0		1.0	2.1	1.0						
Southside Grab	11.7		11.7		2.8		31.5	2.2	1.0						
BECY-17a After	1.0		1.0		1.0	1.0	1.0	1.0	1.0	1.8	1.0	1.0	1.0	1.0	
BECY-17a Grab	1.0		1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
BECY-1	6.4	26.7	29.7	1.0		27.0		10.1	17.0	26.2	1.0	9.3	23.6	1.0	33.5
BECY-2	24.4	30.4	31.6	2.1		28.5		1.3	12.6	24.1	2.7	22.2	28.8	1.0	33.9
BECY-3	17.5	22.7	32.4	2.3		30.4		1.5	33.6	31.1	9.1	26.8	27.2	1.5	33.9
BECY-4r	1.0	1.0	1.0	1.0		1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	7.6
BECY-8r	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	4.7
BECY-15	1.0	1.0	1.0	1.0	1.0	1.0		1.0			1.0	1.0	1.0	1.0	1.0
BECY-16	1.0	1.0	1.0	1.0		1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
BECY-18										14.4	1.0	18.6	31.0	1.3	32.4
BECY-19										7.1	2.3	1.0	1.0	1.0	19.7

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in parts per thousand

Table 21

Year 5 Data Summary - Temperature

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	19.8		11.4		17.4										
BECY-9ra Grab	19.7		8.1		16.1	20.3	22.6			26.5	**	24.5	23.3	16.2	11.9
BECY-9ra Comp						19.4	22.4			26.6	**	23.3	23.4	16.3	10.4
Southside Grab After	20.5		11.7		17.4		22.6	22.1	23.9						
Southside Grab	19.9		9.5		17.0		23.2	22.2	24.5						
BECY-17a After	20.0		11.5		18.0	19.4	22.4	22.6	25.4	27.1	**	23.9	24.5	16.5	
BECY-17a Grab	20.7		11.4		17.7	17.9	22.8	23.2	25.0	28.2	**	23.2	24.6	15.4	
BECY-1	19.8	11.0	13.9	15.1		22.8		**	26.4	29.6	**	23.5	25.5	16.9	13.5
BECY-2	20.5	11.9	14.1	15.7		23.0		**	27.2	30.1	**	24.5	26.0	20.0	13.9
BECY-3	20.2	9.4	12.4	14.9		22.0		23.1	27.3	29.9	**	24.9	26.7	17.4	13.5
BECY-4r	19.2	9.0	11.6	14.7		19.1		22.1	24.9	26.5	**	22.9	24.1	16.9	11.9
BECY-8r	20.5	11.4	13.6	15.1	18.4	21.6		23.5	26.6	28.7	**	24.7	24.5	20.5	12.8
BECY-15	19.1	8.7	10.8	13.7	16.4	18.8		21.2			24.4	22.7	22.2	16.9	11.6
BECY-16	20.2	10.6	13.5	15.6		18.9		**	25.8	28.9	**	23.6	25.4	17.8	12.1
BECY-18										29.2	**	24.1	25.9	17.7	13.0
BECY-19										27.8	**	24.3	24.8	20.4	14.5

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in °C

** Field Instrument Malfunction

Table 22

Year 5 Data Summary - Total Kheldahl Nitrogen* (TKN)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	0.57		0.53		0.43										
BECY-9ra Grab	0.82		0.75		0.50	0.61	1.51			0.40	1.84	1.17	1.29	1.53	1.69
BECY-9ra Comp						0.53	1.79			0.89	1.32	0.66	0.40	1.93	1.57
Southside Grab After	1.19		1.04		0.90		1.49	1.80	0.88						
Southside Grab	0.49		1.35		1.33		2.73	1.79	1.60						
BECY-17a After	0.33		3.72		0.96	1.03	0.79	1.36	2.05	2.03	0.39	1.01	0.61	0.80	
BECY-17a Grab	0.93		0.79		0.73	2.25	0.87	1.46	0.94	1.33	0.41	1.05	0.34	0.48	
BECY-1	0.72	1.13	0.86	0.75		1.51		0.94	2.63	2.59	2.81	1.96	1.03	1.14	1.65
BECY-2	0.78	0.95	0.60	0.74		1.74		1.00	1.43	1.52	1.27	0.13	0.87	0.87	1.59
BECY-3	0.68	0.24	1.04	0.70		1.58		0.81	2.03	1.84	0.86	2.11	0.93	1.06	1.64
BECY-4r	0.71	0.49	0.71	0.67		1.20		1.76	0.81	0.93	1.65	1.68	0.43	0.85	0.50
BECY-8r	0.66	0.45	0.87	0.61	0.62	0.85		0.60	0.80	0.86	0.58	0.67	0.61	0.77	1.72
BECY-15	0.93	0.59	1.12	0.81	1.29	1.32		1.04			1.00	1.39	1.21	2.21	0.77
BECY-16	0.47	0.45	0.72	0.74		0.89		0.67	0.70	0.77	0.77	0.73	0.42	0.65	0.85
BECY-18										1.18	1.81	1.26	1.28	1.01	1.60
BECY-19										0.71	0.44	0.43	0.36	0.35	0.57

*Total Kheldahl Nitrogen is internally tracked for Critical Exceedances Concentration Information. Values greater than 5.8 mg/L are reported monthly to Beaufort County.

Critical Exceedance Concentration information is based on South Carolina Estuarine and Coastal Assessment Program Standards.

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 23

Year 5 Data Summary - Total Organic Carbon (TOC)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	12.10				22.60										
BECY-9ra Grab	17.50				11.00						8.83				
BECY-9ra Comp											10.40				
Southside Grab After	17.50				12.00			10.00							
Southside Grab	6.29				12.80			11.90							
BECY-17a After	14.70				18.30			7.14			7.08				
BECY-17a Grab	22.50				14.10			8.19			3.45				
BECY-1	9.08			22.10				6.57			24.80				
BECY-2	2.06			10.40				7.86			13.10				
BECY-3	4.79			12.80				8.38			8.52				
BECY-4r	26.70			17.90				9.83			18.90				
BECY-8r	13.80			11.70				9.67			8.27				
BECY-15	18.80			15.40				19.40			27.20				
BECY-16	14.40			12.60				10.80			15.40				
BECY-18											32.90				
BECY-19											8.33				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 24

Year 5 Data Summary - Total Suspended Solids (TSS)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	16.8		7.8		3.0										
BECY-9ra Grab	41.9		20.2		6.0	8.4	39.2			9.3	400.0	58.6	32.4	190.0	54.0
BECY-9ra Comp						13.3	360.0			197.0	282.0	36.8	12.5	53.5	29.5
Southside Grab After	14.0		11.8		1.1		29.6	12.5	43.4						
Southside Grab	18.0		34.4		18.4		10.8	4.0	98.4						
BECY-17a After	9.2		60.4		7.0	8.6	41.2	5.9	41.2	14.4	12.6	32.4	52.5	5.5	
BECY-17a Grab	10.4		6.0		7.8	16.6	7.7	2.3	19.2	6.6	24.5	7.2	4.6	7.2	
BECY-1	37.3	22.4	14.6	18.8		11.8		38.6	86.0	63.2	50.0	78.8	11.9	13.6	16.5
BECY-2	31.6	10.0	4.9	34.4		14.0		40.1	56.4	23.9	24.4	70.3	15.0	31.1	9.2
BECY-3	69.0	22.8	16.6	34.0		42.0		59.3	52.4	49.6	42.0	130.0	24.0	71.1	23.6
BECY-4r	9.9	6.4	18.8	9.0		13.0		21.1	7.2	6.0	16.4	26.4	14.7	7.6	7.0
BECY-8r	6.0	7.6	4.8	4.1	23.2	9.4		4.2	32.8	26.4	10.9	14.8	5.6	4.4	6.1
BECY-15	21.2	15.2	18.8	13.2	16.8	37.6		18.8			15.4	18.8	35.5	29.2	15.2
BECY-16	5.6	5.2	4.8	8.6		16.6		9.0	36.6	8.8	9.8	3.3	8.6	5.8	28.8
BECY-18										12.2	2.0	14.0	12.4	10.8	20.0
BECY-19										15.6	9.6	11.6	5.9	12.8	12.6

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in mg/L

Table 25
Year 5 Data Summary - Turbidity

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	33.6		39.4		38.4										
BECY-9ra Grab	28.3		58.1		49.1	36.1	104.2			48.5	**	586.7	62.3	114.9	66.6
BECY-9ra Comp						37.2	587.1			194.8	**	98.1	62.1	109.8	61.8
Southside Grab After	25.2		34.4		31.5		64.3	59.6	8.8						
Southside Grab	25.2		56.1		42.1		30.6	51.2	48.7						
BECY-17a After	28.4		44.7		32.8	31.3	39.2	34.2	18.1	34.2	**	45.8	104.5	49.7	
BECY-17a Grab	25.2		44.5		38.3	56.0	37.9	33.3	16.7	41.6	**	47.5	47.7	54.3	
BECY-1	53.4	33.9	24.3	44.8		34.8		**	47.7	55.7	**	112.0	37.6	67.1	51.8
BECY-2	42.1	31.4	22.3	46.7		38.1		**	30.3	49.1	**	67.2	41.6	71.1	96.1
BECY-3	70.2	34.6	39.7	59.1		75.3		69.2	27.9	64.0	**	180.7	46.6	91.0	55.0
BECY-4r	28.2	37.4	49.0	40.0		46.9		45.8	17.7	45.2	**	54.8	60.2	58.1	55.2
BECY-8r	28.2	39.7	42.5	33.6	40.2	40.8		49.2	27.7	46.7	**	48.4	54.5	54.3	55.3
BECY-15	48.3	47.0	46.8	46.8	59.9	73.1		59.4			**	65.4	138.0	88.5	80.9
BECY-16	22.9	28.6	39.8	33.3		33.4		**	17.3	65.3	**	46.6	47.3	56.2	51.4
BECY-18										46.5	**	51.1	41.5	70.3	59.4
BECY-19										46.1	**	50.4	53.4	118.5	66.2

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler
Sampling Discontinued at Station Southside (August 2012)
Sampling at Stations BECY-18 and BECY-19 added in August 2012
Results reported in Nephelometric Turbidty Units
** Field Instrument Malfunction

Table 26

Year 5 Data Summary - Zinc (Total)

Station	Nov-11 11/17/2011	Dec-11 12/15/2011	Jan-12 1/12/2012	Feb-12 2/28/2012	Mar-12 3/14/2012	Apr-12 4/6/2012	May-12 5/7/2012	May-12 5/15/2012	Jul-12 7/30/2012	Aug-12 8/6/2012	Aug-12 8/29/2012	Sep-12 9/19/2012	Oct-12 10/1/2012	Oct-12 10/9/2012	Nov-12 11/16/2012
BECY-9ra Grab After	12.1				32.3										
BECY-9ra Grab	3.8				8.9						28.6				
BECY-9ra Comp											22.9				
Southside Grab After	10.2				7.5			5.2							
Southside Grab	10.0				9.3			6.9							
BECY-17a After	16.0				22.1			13.5			11.7				
BECY-17a Grab	26.6				28.4			12.3			18.5				
BECY-1	7.0			3.7				10.1			5.8				
BECY-2	12.1			3.6				5.3			4.4				
BECY-3	11.7			3.9				6.9			6.8				
BECY-4r	5.6			3.5				3.7			4.6				
BECY-8r	15.8			17.5				9.1			16.7				
BECY-15	4.4			3.5				7.3			14.1				
BECY-16	3.5			3.5				3.5			3.5				
BECY-18											21.8				
BECY-19											10.2				

'Grab After' refers to a sample collected from water source at the time of sample pick-up from automatic sampler

Sampling Discontinued at Station Southside (August 2012)

Sampling at Stations BECY-18 and BECY-19 added in August 2012

Results reported in µg/L

APPENDIX I

CDM-Smith – Report of Beaufort County Monitoring Program Review

8381 Dix Ellis Trail, Suite 400
Jacksonville, Florida 32256
tel: +1 904 731-7109
fax: +1 904 519-7090
cdmsmith.com

December 4, 2012

Mr. Daniel B. Ahern P.E., BCEE
Stormwater Manager
Beaufort County Stormwater Utility
Building 3, 102 Industrial Village Road
Post Office Drawer 1228
Beaufort, SC 29901-1228

Subject: Beaufort County Monitoring Program Review

Dear Mr. Ahern:

This letter constitutes the CDM Smith Inc. (CDM Smith) review of the Beaufort Count monitoring program. The review examines data collected with respect to the goals of the monitoring program, which were outlined in the 2006 stormwater master plan final report.

Sampling Stations

Tables 1 through 4 provide information about the sampling stations associated with the County monitoring program. These are broken into the following categories:

- Trend stations (Table 1)
- Existing water quality stations (Table 3)
- Best Management Practice (BMP) stations (Table 5)
- Urban runoff water quality stations (Table 7)

For each station, the tables identify the location and years of sampling, and any comments such as relocation of the station.

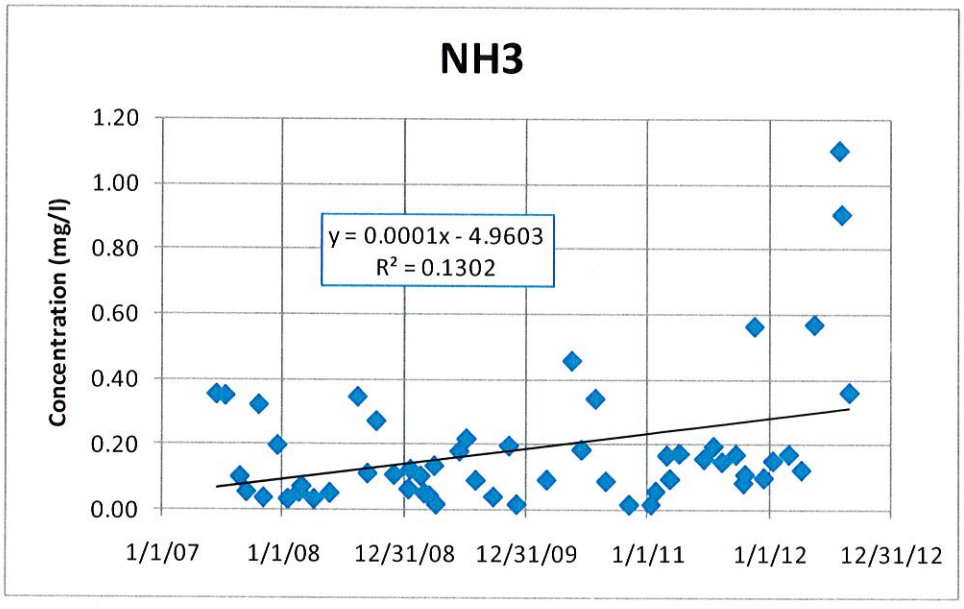
Trend Stations

As shown in **Table 1**, there are 6 trend stations that have been monitored for all 5 years of the County sampling program. The objective of the trend station sampling is to see if the water quality is changing (improving or degrading) over time. The selected areas were identified in the master plan as areas that were expected to see significant new development in the future.

Table 1 Beaufort County Trend Stations

Station	Description	Years	Comment
Trend Water Quality Stations			
BECY-1	Stoney Creek - trend	1 - 5	
BECY-2	Rose Dhu Creek - trend	1 - 5	
BECY-3	Okatie West - trend	1 - 5	
BECY-8 BECY-8r	Battery Creek N - trend	1 - 5	Relocated to BECY-8r after year 1
BECY-9 BECY-9ra Comp BECY-9ra Grab BECY-9ra Grab After	Battery Creek W - trend	1 - 5	Relocated to BECY-9ra after year 1
BECY-14	Village Creek - trend	1 - 4	Discontinued during year 4 (mid-year) - high salinity

Generally, the evaluation of increasing or decreasing trends in concentration over time would be done using statistical analysis. One relatively simple method is a regression analysis, which fits a regression line to the water quality data (independent variable) as a function of the date (dependent variable). An example is shown on the figure below.



As part of the regression analysis, the level of significance of the X-value (slope) can be calculated, to determine if the slope is significant (i.e., if there is an upward or downward trend). In this case, the analysis indicated that the slope was significant (increasing trend), though it appears that the results are influenced by the relatively high measured values in 2012.

Results of the trend analysis are presented in **Table 2**. For each water quality constituent, the table indicates whether the regression analysis indicated "Increase", "No Trend" or "Decrease" during the sampling period, based on a 0.05 level of significance. In most cases, the results showed no significant increase or decrease over time. Several identified trends are as follows:

- Values of TKN and ammonia N showed increasing trends at stations BECY1, BECY2 and BECY3. This appeared to be due to several high values at those stations measured in 2012.
- For the metals, the analysis was affected by the change in detection limit during the monitoring period, and so do not necessarily reflect actual increases or decreases in concentrations during the sampling period. This is particularly true for mercury, where virtually all measurements are at detection limit.
- Trends at stations BECY8 and BECY9 reflect the change in location of the stations during the sampling periods. Both stations show decreasing salinity and conductivity trends, which reflects the movement of the stations to avoid tidal impacts.

Existing Water Quality Stations

As shown in **Table 3**, there are 11 existing quality stations that have been monitored for various lengths of time. The objective of the existing water quality station sampling is to characterize conditions in areas with substantial existing development, and establish a "baseline" quality in areas where retrofit stormwater treatment facilities may be implemented.

Table 4 presents the average concentrations associated with each of the stations, as well as the overall average value. Comparison of the overall value with values at individual stations can reveal which stations have relatively high or low concentrations. Examples of stations with some relatively high concentrations would include BECY6/6R (ammonia N, zinc), BECY10 (fecal coliform), BECY13 (nitrate N), and Southside (chlorophyll-a, copper, phosphorus).

Analysis was done to evaluate how the average concentration at the stations changed as the number of years of data increased. The objective was to determine the number of years of sampling that would result in minimal change to the overall average value (i.e., how many years would adequately characterize the water quality). The results generally showed that 3 to 4 years of data are sufficient to characterize existing water quality.

Table 2 Beaufort County Trend Station Analysis Results

	Trend Station Results					
Constituent	BECY1	BECY2	BECY3	BECY8/8R	BECY9/9RA	BECY14
Ammonia N	Increase	Increase	Increase	No Trend	No Trend	Decrease
BOD	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Cadmium	Decrease	Decrease	Decrease	Decrease	Decrease	No Trend
Chlorophyll-a	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Chromium	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Conductivity	Increase	No Trend	No Trend	Decrease	Decrease	Decrease
Copper	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
DO	Increase	No Trend	Increase	No Trend	No Trend	No Trend
Fecal Coliform	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Iron	No Trend	No Trend	No Trend	No Trend	No Trend	Increase
Lead	Decrease	Decrease	Decrease	Decrease	Decrease	No Trend
Manganese	No Trend	No Trend	No Trend	Decrease	No Trend	No Trend
Mercury	Increase	Increase	Increase	Increase	Increase	No Trend
Nickel	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Nitrate N	No Trend	No Trend	No Trend	No Trend	No Trend	Decrease
pH	No Trend	No Trend	No Trend	Increase	Increase	No Trend
Phosphorus	No Trend	No Trend	Decrease	No Trend	No Trend	Decrease
Salinity	Increase	No Trend	No Trend	Decrease	Decrease	No Trend
Temperature	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
TKN	Increase	Increase	Increase	No Trend	No Trend	No Trend
TOC	No Trend	No Trend	No Trend	Increase	Increase	No Trend
TSS	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend
Turbidity	No Trend	No Trend	Increase	Increase	Increase	No Trend
Zinc	No Trend	No Trend	No Trend	No Trend	Decrease	No Trend

Table 3 Existing Water Quality Stations

Station	Description	Years	Comment
Existing Water Quality Stations			
BECY-4 BECY-4r	Berkley Creek - existing WQ	1 - 5	Relocated during year 3 to BECY-4r - high salinity
BECY-5	Camp St. Marys - existing WQ	1 - 3	Terminated after year 3 - high salinity, low variability
BECY-6 BECY-6r	Grober Hill - existing WQ	1 - 3	Relocated after first year to BECY-6r Discontinued during year 3 - low-variability data
BECY-7 BECY-7ra Comp BECY-7ra Grab BECY-7ra Grab After	Burton Hill - existing WQ	1 - 4	Relocated from BECY-7 and switched to automatic Three years of low variability data Discontinued during year 4
BECY-10	Habersham Creek N - existing WQ	1 - 3	Discontinued during year 3 - low-variability data
BECY-11	Salt Creek South - existing WQ	1 - 3	Discontinued during year 3 - low-variability data
BECY-12	Salt Creek - existing WQ	1 - 4	Discontinued during year 4
BECY-13	Rock Springs Creek - existing WQ	1 - 4	Discontinued during year 4
BECY-15	Marine Corps Air Station - existing WQ	3 - 5	
BECY-16	W fork of Okatie River - existing WQ	3 - 5	
Southside Comp Southside Grab Southside Grab After	Battery Creek watershed	2 - 5	Establish baseline water quality before construction of WQ control structure

Best Management Practice (BMP) Stations

As shown in **Table 5**, there are four BMP stations that have been monitored for various lengths of time. The objective of the BMP sampling stations are to characterize inflow and outflow quality as a means of evaluating pollutant removal efficiency of the BMPs.

Table 6 presents the average concentrations associated with each of the stations. The "BMPep" data reflect sampling at the Eagle's Pointe wet detention pond, with inflow and outflow stations. In some cases, the average outflow concentration exceeds the average inflow concentration, which may be reasonable for constituents such as chlorophyll-a that would grow in the pond, but is difficult to explain for other constituents such as phosphorus, TKN and nitrate N. The outflow stations (BMPep OUT, Christine Place, and BECY-17a) do generally have concentrations that would be considered representative of expected pond discharge water quality, though there are a few high values such as copper in the Eagle's Pointe pond (which has been explored thoroughly by the county in additional sampling studies).

Table 4 Average Concentrations at Existing Water Quality Stations

Constituent	Units	Average Value at Stations			
		BECY4 / 4R	BECY5	BECY6 / 6R	BECY7 / 7ra
Ammonia N	mg/l	0.13	0.08	0.72	0.20
BOD	mg/l	2.98	2.28	3.47	3.58
Cadmium	ug/l	1.54	2.36	1.09	1.21
Chlorophyll-a	ug/l	8.84	5.08	5.30	4.56
Chromium	ug/l	4.76	4.39	2.08	2.61
Conductivity	us/cm	19,326	37,995	11,744	11,100
Copper	ug/l	6.64	9.97	3.10	3.58
DO	mg/l	7.93	5.80	4.92	5.46
Fecal Coliform	#/100 ml	1,396	577	1,150	1,713
Iron	ug/l	1,599	1,057	1,465	1,554
Lead	ug/l	5.16	7.55	2.65	3.76
Manganese	ug/l	142.23	37.05	129.19	83.56
Mercury	ug/l	0.06	0.05	0.05	0.06
Nickel	ug/l	2.55	5.74	1.57	1.48
Nitrate N	mg/l	0.06	0.08	0.24	0.13
pH	---	7.64	7.37	7.22	7.25
Phosphorus	mg/l	0.36	0.19	0.40	0.24
Salinity	ppt	13.20	28.56	7.52	8.50
Temperature	deg C	20.64	22.52	19.26	17.80
TKN	mg/l	0.60	0.24	1.27	0.64
TOC	mg/l	11.62	2.31	13.24	10.49
TSS	mg/l	33.29	45.93	24.82	36.67
Turbidity	NTU	22.50	19.28	27.77	29.66
Zinc	ug/l	12.93	12.70	52.93	18.55

Table 4 Average Concentrations at Existing Water Quality Stations (cont'd).

Constituent	Units	Average Value at Stations			
		BECY10	BECY11	BECY12	BECY13
Ammonia N	mg/l	0.11	0.14	0.25	0.15
BOD	mg/l	2.77	3.16	3.80	2.84
Cadmium	ug/l	1.00	1.00	0.72	0.74
Chlorophyll-a	ug/l	4.52	9.91	8.63	3.92
Chromium	ug/l	2.06	2.36	2.40	2.14
Conductivity	us/cm	513	339	8,982	321
Copper	ug/l	3.48	3.06	3.33	3.50
DO	mg/l	5.45	4.73	5.60	7.14
Fecal Coliform	#/100 ml	9,684	877	2,718	1,692
Iron	ug/l	1,733	8,350	1,851	1,979
Lead	ug/l	2.65	2.84	2.82	2.47
Manganese	ug/l	55.08	341.55	216.14	46.34
Mercury	ug/l	0.05	0.05	0.05	0.05
Nickel	ug/l	1.13	1.99	2.34	1.26
Nitrate N	mg/l	0.06	0.07	0.07	0.89
pH	---	7.16	7.26	7.17	7.13
Phosphorus	mg/l	0.20	0.12	0.29	0.18
Salinity	ppt	1.00	1.00	6.32	1.00
Temperature	deg C	18.56	17.63	18.37	19.48
TKN	mg/l	0.48	0.51	0.76	0.65
TOC	mg/l	9.38	12.03	16.92	9.54
TSS	mg/l	10.94	32.93	41.02	22.89
Turbidity	NTU	21.65	20.07	60.79	21.45
Zinc	ug/l	9.00	16.36	23.31	11.55

Table 4 Average Concentrations at Existing Water Quality Stations (cont'd)

Constituent	Units	Average Value at Stations			
		BECY15	BECY16	Southside	All Stations
Ammonia N	mg/l	0.21	0.14	0.36	0.22
BOD	mg/l	3.93	3.23	5.97	3.45
Cadmium	ug/l	0.11	0.11	1.09	1.07
Chlorophyll-a	ug/l	1.70	12.59	40.55	9.69
Chromium	ug/l	1.99	1.91	2.05	2.75
Conductivity	us/cm	141	424	3,183	9,705
Copper	ug/l	3.21	4.61	23.22	6.37
DO	mg/l	6.03	9.13	2.42	6.03
Fecal Coliform	#/100 ml	1,807	2,032	2,007	2,302
Iron	ug/l	2,295	1,091	755	2,053
Lead	ug/l	0.96	0.54	2.21	3.29
Manganese	ug/l	104.26	47.83	43.04	114.87
Mercury	ug/l	0.07	0.07	0.07	0.05
Nickel	ug/l	1.47	0.95	2.20	2.09
Nitrate N	mg/l	0.11	0.11	0.10	0.18
pH	---	7.22	7.70	7.26	7.31
Phosphorus	mg/l	1.13	0.14	0.74	0.34
Salinity	ppt	1.00	1.00	4.14	7.30
Temperature	deg C	17.35	20.59	17.47	19.19
TKN	mg/l	0.85	0.66	1.14	0.70
TOC	mg/l	22.14	13.51	9.25	11.62
TSS	mg/l	19.58	12.11	37.70	30.50
Turbidity	NTU	42.41	27.89	19.13	29.00
Zinc	ug/l	9.27	3.49	22.50	17.45

Table 5 BMP Stations

Station	Description	Years	Comment
BMP Water Quality Stations			
BMPep - Grab BMPep - Grab After BMPep - IN COMP BMPep - IN GRAB BMPep - OUT COMP BMPep - OUT GRAB BMPep - OUT GRAB After	Eagles Pointe - BMP efficiency	1 - 4	
BECY-17a Grab After BECY-17a Grab	Stormwater pond - county office complex existing water quality	4 - 5	
Christine Place Comp Christine Place Grab Christine Place-R	BMP outflow WQ	3	Wet pond with large bird population Discontinued - good quality (expected bad)

Urban Runoff Water Quality Stations

As shown in **Table 7**, there are four urban runoff water quality stations that have been monitored for various lengths of time. The objective of the urban runoff sampling is to characterize runoff quality from urban land uses (residential, commercial, industrial).

Table 8 presents the average concentrations associated with each of the stations, as well as the overall average value. In comparison with runoff concentrations used in the master plan study, the measured runoff concentrations tend to be lower. Examples include total N (0.85 mg/L TKN + 0.19 mg/L nitrate N = 1.04 mg/L, compared to 1.9 mg/L used in water quality model), total P (0.25 mg/L measured compared to 0.23 to 0.40 mg/L used in water quality model), and fecal coliform (3,793 measured compared to 11,000 to 32,000/100 ml used in the water quality model).

Some of the difference between measured concentrations and expected concentrations may be the sampling techniques used. The expected concentrations are based on sampling studies throughout the southeastern United States, which were generally designed to measure "medium" storm events. In the case of Beaufort County, a "medium" storm event may be on the order of 0.5 inch, based on roughly 50 inches of average annual rainfall and roughly 100 rainfall events per year. With the exception of the year 5 sampling, the data do not indicate the depth of rainfall associated with the sampling events. The reports indicate that the sampled storm events are greater than 0.1 inch. Consequently, the sample data may reflect storms that were relatively small compared to storms sampled in other studies.

Table 6 Average BMP Station Concentrations

Constituent	Units	Average Value at Stations			
		BMPep IN	BMPep OUT	Christine Place	BECY-17a
Ammonia N	mg/l	0.53	0.21	0.39	0.33
BOD	mg/l	4.23	4.39	4.87	7.58
Cadmium	ug/l	1.00	1.00	2.11	0.88
Chlorophyll-a	ug/l	4.35	23.53	15.69	3.78
Chromium	ug/l	2.00	1.71	3.52	2.00
Conductivity	us/cm	388	242	54	376
Copper	ug/l	46.01	61.24	2.54	3.33
DO	mg/l	4.99	4.98	4.56	4.88
Fecal Coliform	#/100 ml	200	153	2,057	3,632
Iron	ug/l	1,257	827	1,275	202
Lead	ug/l	2.50	2.76	2.50	0.98
Manganese	ug/l	13.66	18.47	45.80	21.49
Mercury	ug/l	0.06	0.06	0.07	0.07
Nickel	ug/l	1.74	1.60	1.53	1.08
Nitrate N	mg/l	0.06	0.11	0.14	0.19
pH	---	7.75	7.37	7.52	7.35
Phosphorus	mg/l	0.20	0.35	0.27	0.30
Salinity	ppt	1.00	1.00	1.00	1.08
Temperature	deg C	20.46	22.30	28.53	19.14
TKN	mg/l	1.19	1.79	0.67	1.15
TOC	mg/l	17.06	13.08	14.60	13.82
TSS	mg/l	10.43	14.54	78.33	25.13
Turbidity	NTU	14.27	12.14	13.65	35.93
Zinc	ug/l	7.19	6.05	47.25	22.29

Table 7 Urban Runoff Water Quality Stations

Station	Description	Years	Comment
Runoff WQ Stations			
BECY-1a Comp BECY-1a Grab BECY-1a Grab After	Battery Creek - High Density Resid runoff	1 - 3	Lower than CDM's EMCs so discontinued after year 3
BECY-2a Comp BECY-2a Grab	Albergotti Creek - Industrial runoff	1	Used equipment to monitor wet pond BMP instead BMPep - In Comp and Out Comp
BECY-3a Comp BECY-3a Grab	Lucy Point - Low Density Resid runoff	1	Used equipment to monitor wet pond BMP instead BMPep - In Comp and Out Comp
BECY-4a Comp Becy-4a Grab Becy-4a Grab After	Rock Springs Creek - Medium Density Resid runoff	1 - 3	Lower than CDM's EMCs so discontinued after year 3

Overall Assessment of Monitoring Program

After 5 years the County has collected a substantial amount of water quality data to characterize water quality trends, existing water quality data, BMP performance and urban runoff water quality.

The trend data and the existing water quality data appear to be the most complete data sets. For trend data, the stations showed little in the way of increasing or decreasing trends, which may be due to limited urban development in the sampled areas during the sampling period. Continued sampling of these stations is considered appropriate. For existing water quality stations, the analysis suggests that 3 or 4 years of complete sampling data are sufficient to define the existing water quality conditions.

The BMP sampling and urban runoff sampling appears to be less complete. This may be due to the lower priority given to these kinds of sampling in the original review of the monitoring program back in 2008. The lower priority at that time was based on the abundance of BMP sampling and urban runoff quality sampling done elsewhere, assuming that local values were likely to be consistent with the findings of other studies.

Table 8 Average Urban Runoff Concentrations

Constituent	Units	Average Value at Stations				
		BECY-1A	BECY-2A	BECY-3A	BECY-4A	TOTAL
Ammonia N	mg/l	0.10	0.22	0.10	0.14	0.12
BOD	mg/l	5.84	2.95	4.74	4.49	5.07
Cadmium	ug/l	1.73	1.93	1.13	2.24	1.88
Chlorophyll-a	ug/l	28.81	10.70	5.50	1.26	16.11
Chromium	ug/l	2.81	3.57	0.50	1.98	2.37
Conductivity	us/cm	1,601	31,783	---	98	3,531
Copper	ug/l	5.07	1.89	3.61	4.67	4.50
DO	mg/l	3.80	4.93	---	5.82	4.60
Fecal Coliform	#/100 ml	4,919	27	1,250	3,245	3,793
Iron	ug/l	423	2,890	635	517	597
Lead	ug/l	6.38	11.90	2.50	4.59	5.70
Manganese	ug/l	39.25	13.70	23.63	13.89	25.78
Mercury	ug/l	0.11	0.60	0.06	0.11	0.13
Nickel	ug/l	1.69	1.00	1.00	1.36	1.48
Nitrate N	mg/l	0.08	0.71	0.06	0.25	0.19
pH	---	7.26	6.94	---	8.61	7.76
Phosphorus	mg/l	0.28	0.57	0.11	0.17	0.25
Salinity	ppt	5.68	20.54	1.00	1.00	4.29
Temperature	deg C	22.55	29.41	---	20.65	22.48
TKN	mg/l	0.92	1.34	1.03	0.68	0.85
TOC	mg/l	11.53	2.54	15.05	12.22	11.55
TSS	mg/l	25.99	105.07	11.50	21.16	28.04
Turbidity	NTU	13.03	---	---	12.85	12.95
Zinc	ug/l	17.57	97.25	26.35	26.34	25.72

With the adoption of new stormwater runoff volume controls, it may be appropriate to consider the monitoring of one or more runoff volume control facilities (e.g., rain gardens) to evaluate both incoming water quality (urban runoff water quality) and the volume control benefits of the facility. One possibility for a rain garden would be to measure ponding depth in the rain garden (which would at most times be zero) to see how often that ponding occurs and how often the overflow structure is used. The data could also be used to estimate inflow quantities and perhaps even support modeling of the rain garden in the EPA SWMM5 model. Water quality samples collected during the times of ponding could be used to characterize urban stormwater runoff quality.

Review of the data indicated that the fecal coliform data and some of the metals data appeared to have indeterminate (e.g., ">1600" for fecal coliform) or varying minimum reported values over time (e.g., lead reported minimum concentration of 2.5 ug/l in year 1, compared to 0.5 ug/l in year 5). For purposes of determining data averages or of analyzing potential trends in concentrations, it is desirable to maintain consistent minimums for reporting the concentration data. Given that some metals often appear to be at the reporting limit, consideration may be given to dropping some of the metals from analysis and maintaining those that are often above the reporting limit (e.g., copper, zinc). For fecal coliform, it appears that selecting the appropriate dilution is key to producing a determinate value.

Feedback from County staff indicates that limiting the number of metals tested would result in cost savings, if the number of metals was less than four. Copper and zinc are two metals that should definitely be included in future monitoring. Cadmium or lead would be suitable candidates for the third tested metal.

Please call me at (904) 527-6706 if you have any questions or require further information.

Sincerely,

Richard Wagner

Richard Wagner, PE, D.WRE
Principal Water Resources Engineer
CDM Smith Inc.

cc: Phil Parkins, CDM Smith
Robert Klink, Beaufort County