COUNTY COUNCIL OF BEAUFORT COUNTY
BEAUFORT COUNTY ENGINEERING DIVISION
Building 3, 102 Industrial Village Road
Post Office Drawer 1228, Beaufort, SC 29901-1228
Phone: (843) 470-2625 Fax: (843) 470-2630

TO: Don Smith, Chairman, Storm Water Utility Board

FROM: Bob Klink, PE, County Engineer
Dan Ahern, PE, Manager, Stormwater Management

SUBJ: **Eagle's Point PUD Stormwater Water Quality Monitoring & Testing**

DATE: April 15, 2009

BACKGROUND As part of the Eagle's Point PUD approval in 1996, the Developer agreed to provide stormwater water quality monitoring and testing for the Development and the Okatie River. This water quality monitoring and testing program was originally reviewed and recommended for approval by CDM back in 1996. The Engineering Division and Stormwater Utility Division recently sent over 11 years of Eagle's Point stormwater water quality monitoring and testing data to CDM for their review and recommendations for future monitoring and testing.

CDM has recently completed a very comprehensive review and analysis of a significant amount of data and have concluded that the Eagle's Point stormwater treatment facilities are providing a very high level of stormwater treatment with the exception of some elevated copper levels. Based on their review and analysis, CDM is recommending that the Eagle's Point stormwater quality monitoring and testing be dropped with the condition that Eagle's Point work with the County to identify and reduce the copper levels exiting the development.

The Eagle Point PUD has met with the County and has indicated that they would readily work with the County to identify and reduce the copper levels exiting the Development.

RECOMMENDATION That the Stormwater Utility Board approve and recommend to County Council that the CDM recommendation be adopted, and remove the stormwater water quality monitoring and testing requirement from Eagle Point PUD.

REK/DA/pae

Attachment: 4/6/09 CDM's Eagle's Point Report

Stormwater/09-07

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

April 6, 2009

Mr. Robert Klink, P.E.
Beaufort County Engineering Division
Post Office Drawer 1228
Beaufort, SC 29901-1228

Subject: Review of the Eagle's Pointe Water Quality Monitoring Program Data

Dear Mr. Klink:

This letter documents CDM's review of the Eagle's Pointe water quality monitoring data collected in the years 1997 through 2007.

Overview of the Monitoring Program

The monitoring program that has been implemented by the Eagle's Pointe Property Owners Association, includes the following elements:

- Water column physiochemical sampling at four stations. These stations include tributary stations upstream and downstream of the Eagle's Pointe site, an Okatie River site, and the Pinckney Colony pond outfall location.
- Sediment chemistry sampling, also collected upstream and downstream of the site, and in the Okatie River.
- Benthic macroinvertebrate sediment sampling, also done upstream and downstream of the site, and in the river.

The overall program is designed to focus on water quality trends and bottom sediment impacts downstream of the site in the tributary and in the Okatie River.

Physiochemical Sampling Results

The physiochemical sampling has collected data for the following constituents:

- Total organic carbon (TOC)
- Total dissolved solids (TDS)
- Total suspended solids (TSS)

- Biochemical oxygen demand (BOD)
- Total Kjeldahl nitrogen (TKN)
- Ammonia nitrogen (NH3-N)
- Nitrite+nitrate nitrogen (NO3-N)
- Total phosphorus (TP)
- Dissolved phosphorus (DP)
- Fecal coliform bacteria (FC)
- Cadmium
- Copper
- Lead
- Zinc
- pH
- Dissolved oxygen (DO)
- Salinity
- Water temperature
- Total petroleum hydrocarbons – gasoline range organics (TPH-GRO)
- Total petroleum hydrocarbons – diesel range organics (TPH-DRO)

In general, all of these constituents have been measured at the four station mentioned earlier (two tributary stations, river station, pond outfall) on a quarterly basis since 1997, and the most recent report includes data through March 2007.

The sampling data can be used to perform several analyses. These include the following:

- Review data at individual tributary and river stations, to see if a trend (i.e., increasing or decreasing concentrations) can be determined. In the annual monitoring reports, this type of analysis was done for the macroinvertebrate data, but not for the physiochemical data.

- Review data at stations upstream and downstream of the site, to see if there is a significant difference in concentration at the two stations.

- Compare concentration data at all stations against corresponding water quality standards and criteria.

- Compare average pond outfall concentration data to expected concentrations based on values of runoff concentrations and wet pond removal efficiencies documented in the County BMP Manual.

These comparisons were made by CDM, for a limited number of water quality constituents, which included TSS, BOD, DO, TP, TN, FC, and copper. The results are summarized below.

Trend Analysis

Trend analysis was based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was analyzed to determine the probability value P that there is an increasing or decreasing concentration with time. For this analysis, a P value of 0.05 or less was considered "statistically significant".

In general, the statistical tests showed no trends in concentrations. The exceptions are:

- At station T-1, upstream of the site, results showed an increasing trend in the concentration of TN. No trend was detected either at station T-2 or the Okatie River station.

- At station T-2, downstream of the site, results showed an increasing trend in the concentration of copper. No trend was detected at station T-1 or the Okatie River station.

The increasing trend at station T-2 for copper suggests that the Eagle's Pointe site may be a source of copper that is having an impact on downstream concentrations in the tributary, though not significantly affecting the river.

Tributary Site Comparisons

Comparison of concentrations at stations T-1 and T-2 was also based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was compared to determine the probability value P that there is an increasing or decreasing concentration with location. Again, a P value of 0.05 or less was considered "statistically significant".

The results indicated no significant difference between the concentrations at the tributary stations for five of the seven analyzed constituents. The exceptions are:

- Significant difference was determined for TSS, with lower concentration at station T-2 (downstream of the site), and
- Significant difference was determined for copper, with higher concentration at station T-2.

Again, the significantly higher copper concentration at station T-2 suggests that the Eagle's Pointe site may be a source of copper that may have an impact on downstream concentrations in the tributary.

Comparison with Water Quality Standards/Criteria

Most of the water quality constituents analyzed do not have specific water quality standards or criteria. This would include TP, TN, and BOD. There is a standard for turbidity that is related in part to TSS concentrations, but the relationship tends to be site-specific. Consequently, the discussion below focuses on DO, FC, and copper.

DO

For DO, the standard for freshwaters (FW) are a daily average not less than 5 mg/l, with a low of 4.0 mg/l. Review of the tributary station data show that the samples were below the 5.0 mg/l threshold 29% of the time at both T-1 and t-2 stations, and below 4.0 mg/l 10-13% of the time. It is not uncommon to see low DO values in small tributaries, particularly in the warm summer months. At the Okatie River site, the samples were below the 5.0 mg/l

threshold 22% of the time, and below 4.0 mg/l only 2% of the time. It should be noted that the Okatie River is classified as "Outstanding Resource Waters" (ORW), and the DO standard is actually a narrative stating that "Water quality conditions will be maintained and protected to the extent of the department's statutory authority."

Fecal Coliform

For FC, the FW standard is not to exceed a geometric mean of 200/100 ml, based on five consecutive samples during any 30-day period, and no more than 10% of the total samples during any 30-day period are allowed to exceed 400/100 ml. Since the tributary samples are taken quarterly, the data cannot be directly compared to the standard. For the entire sampling period, the geometric means at stations T-1 and T-2 are 69/100 ml and 45/100 ml, respectively. At both stations, the value of 400/100 ml is exceeded more than 10% of the time.

For shellfish harvesting waters (SFH), the FC standard is not to exceed a geometric mean of 14/100 ml, and no more than 10% of the samples are allowed to exceed 43/100 ml. For the sampling period, the geometric mean at the river station is 3.8/100 ml, and only 2 of the 41 samples (5%) exceed the 43/100 ml value. Again, because the Okatie River is classified as ORW, the actual standard is a narrative, which is the same as for DO.

Copper

The FW aquatic life criteria for copper include values of 3.8 ug/l for the Criteria Maximum Concentration (CMC) and 2.9 ug/l for the Criterion Continuous Concentration (CCC). The CMC is an estimate of the highest concentration to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. In contrast, the CCC is an estimate of the highest concentration to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. These values are very low, considering that stormwater runoff from residential areas is expected to have an average copper concentration of 24 ug/l (see Table 3-3 of the County BMP Manual).

Based on these values, both of the tributary stations have measured concentrations that frequently exceed the CMC and CCC for copper. At the upstream station T-1, the CMC is exceeded 31% of the time, and the CCC is exceeded 72% of the time. At the downstream station T-2, the CMC is exceeded 58% of the time, and the CCC is exceeded 83% of the time. At both stations, the frequency of exceedance is higher for samples on or after 8/22/2000, the date at which copper concentrations at the Pinckney Colony pond outfall are consistently above the sampling detection limit.

The saltwater aquatic life criteria for copper include values of 5.8 ug/l for the Criteria Maximum Concentration (CMC) and 3.7 ug/l for the Criterion Continuous Concentration (CCC). At the Okatie River site, the CMC is exceeded 10% of the time, and the CCC is exceeded 15% of the time. The frequency of exceedance before and after 8/22/2000 is roughly the same, suggesting that the increased copper concentrations at station T-2 are not affecting the attainment of the copper criteria in the river.

Comparison of Expected and Measured Pond Concentrations

Expected pond concentrations were determined by selecting typical runoff concentration values and wet detention pond pollutant removal values from the County BMP Manual. These values were then compared to the average concentrations measured in the pond. The results are as follows:

- TSS: Typical values include runoff concentration of 117 mg/l and pond removal efficiency of 90% (Tables 3-3 and 3-9 of the BMP Manual). The average expected concentration would be 12 mg/l, compared to the measured value of 12 mg/l.

- BOD: Based on runoff concentration of 11 mg/l and removal efficiency of 40%, the expected concentration would be 6.6 mg/l. The average measured pond concentration is 2.1 mg/l, substantially lower than the expected value.

- TP: Based on runoff concentration of 0.4 mg/l and 60% pond removal efficiency, the expected concentration would be 0.16 mg/l, almost the same as the average measured concentration of 0.15 mg/l.

- TN: Based on runoff concentration of 2.0 mg/l and removal efficiency of 35%, the expected concentration would be 1.3 mg/l, again very close to the average measured concentration of 1.34 mg/l.

- FC: Based on runoff concentration of 32,200/100 ml and pond removal of 80% (Tables 3-7 and 3-10 of the BMP Manual), the expected concentration would be 6,440/100 ml, which is much higher than the average measured value of 130/100 ml. Previous analysis of the Eagle's Pointe ponds suggested that the removal efficiency may be expected to be substantially higher than 80% because the ponds provide a very long residence time (average residence time of 100 days or more), beyond the pond design standards in the BMP Manual (average two-week residence time during the wet season).

- Copper: Based on runoff concentration of 24 ug/l and pond removal efficiency of 65%, the expected concentration would be 8 ug/l, which is substantially lower than the average measured concentration of 29 ug/l. For samples on or after 8/22/2000, the average measured concentration is 40 ug/l. Prior to 8/22/2000, eight samples were taken and copper was below detection limit for all eight samples.

With the exception of copper, the measured pond concentrations are at or below what would be expected in a properly-functioning pond system.

Sediment Chemistry Sampling Results

The sediment chemistry sampling has collected data for the following constituents:

- Percent solids
- Total organic carbon (TOC)
- Cadmium
- Copper
- Lead
- Zinc
- Percent shell
- Percent sand
- Percent silt/clay

In general, all of these constituents have been measured at the two tributary stations and the river station, on an annual basis since 1997, and the most recent report includes data through March 2007.

The sampling data can be used to perform several analyses. These include the following:

- Review data at individual tributary and river stations, to see if a trend (i.e., increasing or decreasing concentrations) can be determined. In the annual monitoring reports,

this type of analysis was done for the macroinvertebrate data, but not for the sediment chemical data.

- Review data at stations upstream and downstream of the site, to see if there is a significant difference in concentration at the two stations.
- Compare concentration data at all stations against corresponding water quality standards and criteria.

These comparisons were made by CDM for the metals data. The results are summarized below.

Trend Analysis

Trend analysis was based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was analyzed to determine the probability value P that there is an increasing or decreasing concentration with time. For this analysis, a P value of 0.05 or less was considered "statistically significant".

In general, the statistical tests showed no trends in concentrations. The only exception was for copper at station T-2. There, the results showed an increasing trend in the concentration of copper. No similar trend was detected at station T-1 or the Okatie River station.

The increasing trend at station T-2 for copper again suggests that the Eagle's Pointe site may be a source of copper that is having an impact on downstream concentrations in the tributary, though not significantly affecting the river.

Tributary Site Comparisons

Comparison of concentrations at stations T-1 and T-2 was also based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was compared to determine the probability value P that there is an increasing or decreasing concentration with location. Again, a P value of 0.05 or less was considered "statistically significant".

The results indicated no significant difference between the concentrations at the tributary stations for three of the four metals. The exception was zinc, which actually showed that the sediment zinc concentrations were lower at downstream station T-2 than at upstream station

T-1. Even though the trend analysis showed copper increasing at station T-2, the absolute copper levels there are not significantly higher than at the upstream station T-1.

Comparison with Water Quality Standards/Criteria

Earlier annual reports cited Effect Range Low (ERL) and Effect Range Medium (ERM) values for the four metals. The ERL is defined as a concentration below which biological effects are rarely associated. In contrast, the ERM is defined as a concentration above which biological effects are frequently associated. The discussion below indicates how the measured sediment concentrations correspond to the ERL and ERM for the metals.

The results almost always showed concentrations below the ERL at all stations. For cadmium, the ERL and ERM are 1.2 and 9.6 mg/kg, respectively. No measurements exceeded the ERL value; the highest value measured was 0.28 mg/kg at station T-1 in March 2004. The ERL and ERM for copper are 34 and 270 mg/kg, respectively. Only one measurement exceeded the ERL, and that value (80 mg/kg) was measured at upstream station T-1 in March 2003. All other measurements were 13 mg/kg or lower. For lead, the ERL and EML are 46.7 and 218 mg/kg, respectively. No measurements exceeded the ERL value; the highest value measured was 33 mg/kg at station T-1 in March 2003. The ERL and EML for zinc are 150 and 410 mg/kg, respectively. No measurements exceeded the ERL value; the highest value measured was 68 mg/kg at the river station in March 2005.

Benthic Macroinvertebrate Analysis

The benthic macroinvertebrate sampling has produced data for the following constituents:

- Total abundance (i.e., number of specimens)
- Taxa richness (i.e., number of distinct taxonomic groups)

In general, all of these constituents have been measured at the two tributary stations and the river station, on an annual basis since 1997, and the most recent report includes data through March 2007.

The sampling data can be used to perform several analyses. These include the following:

- Review data at individual tributary and river stations, to see if a trend (i.e., increasing or decreasing abundance or richness) can be determined. In the annual monitoring reports, this type of analysis was done for the macroinvertebrate data.

- Review data at stations upstream and downstream of the site, to see if there is a significant difference in abundance or richness at the two stations.

These comparisons were made by CDM, and the results are summarized below.

Trend Analysis

Trend analysis was based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was analyzed to determine the probability value P that there is an increasing or decreasing abundance or richness with time. For this analysis, a P value of 0.05 or less was considered "statistically significant".

In general, the statistical tests showed no trends in abundance or richness. The only exception was for taxa richness at upstream station T-1. There, the results showed an increasing trend in taxa richness. No similar trend was detected at station T-2 or the Okatie River station.

Tributary Site Comparisons

Comparison of abundance and richness at stations T-1 and T-2 was also based on the Analysis of Variance (ANOVA) approach used in the annual reports for the benthic macroinvertebrate analysis. The time series of concentrations was compared to determine the probability value P that there is an increasing or decreasing abundance or richness with location. Again, a P value of 0.05 or less was considered "statistically significant".

The results indicated no significant difference between the abundance or richness at the tributary stations.

Conclusions and Recommendations

Based on the analysis of the Eagle's Pointe water quality monitoring program data, CDM draws the following conclusions:

- The measured water quality data suggest that the wet detention pond system in Eagle's Pointe is effectively treating stormwater runoff from the development.
- Measured concentrations of copper in the pond, and in water and sediment samples downstream of the pond at station T-2, suggest an additional source of copper (e.g., copper sulfate application to the pond system) within the site.

- There is no evidence that the high copper concentrations in the water at the pond and station T-2 are having an adverse effect on copper concentrations in the river or benthic macroinvertebrates downstream of the site.

CDM believes that the data collected since the inception of the program in 1997 is sufficient to demonstrate that the Eagle's Pointe development is not having adverse impacts on the Okatie River. However, the routinely high concentrations of copper in the pond and downstream station T-2 should be explored further to identify the source of the copper and, if possible, to minimize or eliminate this source.

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

Sincerely,

Richard Wagner

Richard Wagner, P.E. D.WRE
Principal
Camp Dresser & McKee Inc.

cc: W. Lagarenne, CDM