# NC Division of Water Resources Water Sciences Section Intensive Survey Branch

March 19, 2015

#### **MEMORANDUM**

To: Jim Gregson

From: Joseph Smith

- CC: Jason Green Dianne M. Reid
- Subject: Hawkins Creek Sediment Study Swansboro Onslow County 12 digit HUC: 030203010304

#### **Summary**

Attached are the results of a survey conducted by the Intensive Survey Branch (ISB) on March 4<sup>th</sup> 2015 of Hawkins Creek and neighboring Dennis Creek at the request of the Wilmington Regional Office (WiRO) to assess potential sediment accretion from the surrounding watershed and nearby stormwater control structures. A total of 12 sites, 10 in Hawkins Creek and 2 in Dennis Creek were assessed by ISB. Sediments in the lower portion of Hawkins Creek and the entirety of Dennis Creek were typical of the Carolinian Barrier Islands and Coastal Marshes Level IV Ecoregion, with deep organic mud and sections of oyster reef. Upstream areas of Hawkins Creek were more representative of an urbanized stream, with incised banks indicative of heavy, flashy flow and a large amount of sand sediment in the stream bed. Sand substrate was documented from the most upstream point sampled (HC 1) to 610 yards downstream (HC 7). Specific investigation of the outfall area from a recent stormwater discharge that occurred on January 9th indicated sand deposition both up and downstream of the discharge site on Hawkins Creek.

# A Synoptic Sediment Study of Hawkins Creek

Hawkins Creek, Onslow County 12 digit HUC: 030203010304

March 19, 2015

## NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WATER RESOURCES

WATER SCIENCES SECTION

#### **Background**

Hawkins Creek is a small urban creek heavily influenced by the tide from nearby Bogue inlet and urban runoff from Highway 24 and a large portion of the town of Swansboro. The watershed area is 0.3 square miles, and is generally low lying. The local soil of the drainage basin is almost exclusively hydrological soil types A and B, defined by the USDA as soils with a low runoff potential, but a high percentage of sand relative to other soil types. Hawkins Creek is also characterized with up to 76% development, and 22 % impervious surface in the drainage basin (Appendix A). The tidal section of Hawkins Creek has been channelized in the past, however much of it has since filled in. Adjacent to the creek are neighborhoods, with retaining walls in place to limit erosion. Sediment barriers are also prevalent on the majority of the mestern bank of Hawkins Creek. Mr. John Freshwater indicated that these were installed during the mid-1990's to control runoff from Highway 24 construction. On January 21<sup>st</sup>, 2015 the Biological Assessment Branch (BAB) conducted an in stream analysis of benthic invertebrates in Hawkins Creek and Dennis Creek. Hawkins Creek was found to have decreased biotic diversity when compared to nearby Dennis Creek as well as pollution resistant dominant taxa. The Dennis Creek watershed is characterized by less overall development at 56% and less impervious surface at 11%, than Hawkins Creek (Appendix B).

#### <u>Methods</u>

Bottom sediment was qualitatively assessed using coring devices on transects where sand was observed in the wadeable reach of the stream and as single point samples in the deeper stretches of Hawkins Creek. Comparative samples from 2 sites in Dennis Creek were collected as reference cores (Table 1).

Site	Latitude	Longitude	# of Cores
HC 1	34.69118	-77.12772	3
HC 2	34.69062	-77.12796	1
HC 3	34.69052	-77.12794	3
HC 4	34.69004	-77.12785	3
HC 5	34.68949	-77.12759	3
HC 6	34.68929	-77.12733	1
HC 7	34.68917	-77.12716	1
HC 8	34.68833	-77.12707	3
HC 9	34.68752	-77.12766	1
HC 10	34.68625	-77.12721	1
DC 1	34.68475	-77.13191	1
DC 2	34.68319	-77.13113	1

Table 1- Sites with corresponding coordinates

Pictures were taken to give a relative idea of bottom composition. Bottom bathymetry was measured at 4 sites representative of the upstream study area of Hawkins Creek (Figure 1).



Figure 1- Hawkins Creek and Dennis Creek, denoting transect and sediment core sites.

#### **Bathymetric Cross Sections**

Stream cross section profiles were measured from water line to water line at low tide. In the upper stretch of Hawkins Creek, bathymetry was typical of a small creek; at low tide depth averaged 4.6 inches in the upper reach, with a few sand bars and minor bends. The reach of Hawkins Creek downstream of HC 8 was characterized by shallow oyster shoals along the western bank with emergent marsh. A channel had previously been dredged close to the right bank but has filled to a depth of a few feet. See Figures 2 through for Cross section profiles of the streambed from sites HC 1, HC 3, HC 4, and HC 6.



Figure 2- Transect of HC 1, most upstream site characterized by minor channelization along the right bank. Sediment here was sandy with leaf litter accumulation along the banks



Figure 3- Transect of HC 3, large sand deposit from 7.8' to 13.3' from right bank.



Figure 4- Transect of HC 4, channelization along left bank, just downstream of discharge point, emergent salt marsh along the right bank.



Figure 5- Transect of HC 6, located upstream of a stormwater drain pipe. Sides of creek were organic mud on the right bank.

#### **Results of Core Sampling**

Twenty two cores were collected during this study: 2 from Dennis Creek, 2 from runoff areas (HC 4 & HC 2) and 17 from Hawkins Creek. Sand sediment was present in 13 out of the 22 cores taken; these 13 cores were from the upstream Hawkins Creek study area, sites HC1 – HC 7. Sediment classifications were defined as inorganic sand or organic mud and the ratio of the two was visually estimated for each core by measuring corresponding depth of sand or mud in each core collected. Sediment in Hawkins Creek was characterized by a deep layer of organic mud in lower reaches, with an increasing percentage of sand further upstream. A transition zone exists close to the widening of the creek bed where an upper sand layer transitions to organic mud proximal to HC 7. This transition zone can be seen in figures 6 and 7 below.



Figure 6- Estimated percentages of inorganic sand in core samples from visual comparison. See Figure 7 for description and sample location of individual site cores.



Figure 7- Comparison of sediment cores taken midstream in Hawkins and Dennis Creek.

#### Longitudinal Core Descriptions from Downstream to Upstream

There was little difference between samples collected in lower Hawkins Creek and neighboring Dennis Creek, as seen below in figures 8 and 9. Lower reaches of Dennis and Hawkins Creek were characteristic of tidal marsh and creek systems, a thick layer of organic silt and mud were found on the bottom with little layering present. Sediment was very fine and easily suspended.







Moving upstream, beginning at HC 7, a layer of sand was visible over laying the organic mud. Sand was found mid channel only in the stretch between sites HC 7 to HC 6 (Appendix C) with the sides of the channel being a continuation of the silt organic mud mixture extending into emergent marsh.

Site HC 4 was the first with visible sand pack, with little organic bottom sediment visible on top of the sand layer (Figure 10).



Figure 10- Site HC 4, first visible mass accumulation of sand sediment in the stream bed.

Site HC4 was immediately downstream of the site of the recent Ward Farm LLC discharge into Hawkins Creek. Some sand sediment was noted in the creek bed, an additional core was taken in stream where the discharge entered the creek (Figure 11). Field measurements indicated approximately 6 cm of sand layered on top of leaf particulates; however no noticeable sediment was visible further up the stream bank. Water flowing through the discharge drainage area was visibly turbid.



Figure 11- Sediment from site of Discharge at HC 4.

Sand depth in core profiles increased from HC 4 upstream of with the largest observable amount seen between site HC 3 and HC 1. Site HC 2 was located at a groundwater seep that was observed with steady flow of slightly turbid water flowing over leaf and root pack to the stream bed. A core taken in the groundwater seep contained approximately 8 cm of sand layered on leaf and root matter (figure 12).



Figure 12- Core from seep seen at site HC 2.



Figure 13- Looking upstream into the groundwater seep from the creek bed of Hawkins Creek. Note sediment barriers, and bank incision.

HC 1 was the most upstream site sampled; cores featured a large amount of sand, with some root matter seen at depth. Core samples contained no observable organic mud (Figure 14).



Figure 14- Stratified sediment from core adjacent to right bank at HC 1.

Above HC 1 is a pool at the base of a concrete dam, behind the dam Hawkins Creek is heavily modified and culverted continuing under Highway 24 and beyond into Swansboro. An earthen weir like structure is visible 10 yards downstream of the culvert running under Highway 24. It is not known if this was an intentional sediment barrier installed during construction or the result of a possible failure of the road fill around the culvert from a previous wash out (Figure 15). Upstream of Highway 24 Hawkins Creek has been heavily modified for storm water management.



Figure 15- limestone weir structure with Highway 24 in beyond.

#### **Conclusion**

Hawkins Creek exhibited an accumulation of inorganic sand from Highway 24 to a point approximately 700 yards downstream. The apparent stratification and volume of the sand in the stream bed is indicative of long term deposition from multiple sources, most likely related to stormwater drainage over a period of time. Higher percentages of sand were observed in cores taken from the upstream portion of the Hawkins Creek study area, while core results show a transition zone of sand to organic mud towards the downstream portion of the creek. Inorganic sediments were observed both above and below the site of the recent discharge from the Ward Farm Property with larger streambed sediment concentrations noted in the upstream portion of the study area. Due to the qualitative nature of the study, sources of sediment could not be discerned. These observations support the recent aquatic life benthic survey conducted by BAB which found reduced diversity and a prevalence of pollution resistant taxa in Hawkins Creek.

For further information or to have any questions answered please contact the Intensive Survey Branch at 919-743-8496

### Appendix A-

# **Basin Characteristics Report Hawkins Creek**

Parameter	Value
Area in square miles	0.3
Minimum basin elevation, in feet	-0.51
Maximum basin elevation, in feet	37.7
Average basin elevation, in feet	26
Elevation at outlet, in feet	0
Perimeter in miles	3.77
Mean basin slope, based on slope percent grid	2.95
Percent of area covered by barren rock using 2006 NLCD	0.000
Percent of area in cultivation using 2006 NLCD	5.602
Percent of area covered by all densities of developed land using 2006 NLCD	75.968
Percent of area covered by forest using 2006 NLCD	10.545
Percent of area covered by grassland/herbaceous using 2006 NLCD	2.044
Percent impervious of basin area 2006 NLCD	21.55
Mean annual precipitation in inches	56.7
Percent of area covered by shrubland using 2006 NLCD	4.488
Percent of area hydrologic soil 'A' defined by SSURGO	29
Percent of area hydrologic soil 'B' defined by SSURGO	69.7
Percent of area hydrologic soil 'C' defined by SSURGO	0
Percent of area hydrologic soil 'D' defined by SSURGO	0
Percent of area covered by water using 2006 NLCD	0.292
Percent of area covered by wetland using 2006 NLCD	1.060

Taken from USGS streamstats program

http://streamstatsags.cr.usgs.gov/gisimg/Reports/BasinCharsReport175732\_201531261859.htm

### <u>Appendix B –</u>

# **Basin Characteristics Report Dennis Creek**

Parameter	Value	
Area in square miles		
Minimum basin elevation, in feet		
Maximum basin elevation, in feet		
Average basin elevation, in feet		
Elevation at outlet, in feet	0	
Perimeter in miles	1.76	
Mean basin slope, based on slope percent grid	4.03	
Percent of area covered by barren rock using 2006 NLCD	0.000	
Percent of area in cultivation using 2006 NLCD	18.824	
Percent of area covered by all densities of developed land using 2006 NLCD	56.018	
Percent of area covered by forest using 2006 NLCD	13.484	
Percent of area covered by grassland/herbaceous using 2006 NLCD	7.376	
Percent impervious of basin area 2006 NLCD		
Mean annual precipitation in inches		
Percent of area covered by shrubland using 2006 NLCD	2.986	
Percent of area hydrologic soil 'A' defined by SSURGO	11.8	
Percent of area hydrologic soil 'B' defined by SSURGO	84.8	
Percent of area hydrologic soil 'C' defined by SSURGO	2.13	
Percent of area hydrologic soil 'D' defined by SSURGO	0	
Percent of area covered by water using 2006 NLCD	0.000	
Percent of area covered by wetland using 2006 NLCD	1.312	

Taken from USGS streamstats program

http://streamstatsags.cr.usgs.gov/gisimg/Reports/BasinCharsReport191494\_2015320132529.htm

Appendix C- Pictures of Cores



HC 1- Right bank, 50%-75%



HC 1- Midstream, >75% sand



HC- 1 Left bank, >75% sand



HC 2- Core from midstream of the seep, >75% sand



HC 3- Right bank, >75% sand



HC 3- Midstream, >75% sand



HC 3- Left bank, 50% - 75%



HC 4- Core midstream of discharge runoff from Ward Farm property, 50% - 75%



HC 4- Right bank, 25% - 50% sand



HC 4- Left bank, first visible sand accumulation going upstream, >75% sand



HC 4- Looking upstream towards site of discharge from Ward Farm property



HC 5- Right bank 0% sand



HC 5- Midstream, < 25% sand



HC 5- Left bank, 0% sand



HC 6- Midstream, < 25% sand



HC 7- Midstream, < 25% sand



HC 8- Right bank, 0% sand

HC 8- Midstream 0% sand



HC 8- Left Bank, 0% sand

HC 9- Midstream, 0% sand



HC 10- Midstream, 0% sand

### Dennis Creek



DC 1, 0% sand

DC 2, 0% sand