

A RESOLUTION ACCEPTING A REPORT ON  
BENTHIC MACROINVERTEBRATE SURVEYS IN BOLIN CREEK  
Resolution No. 91/2006-07

WHEREAS, the Carrboro Board of Aldermen has established environmental protection, especially for our major watercourses and their watersheds, as a high priority; and

WHEREAS, the Carrboro Board of Aldermen made clear their commitment to the sensitive ecology of Bolin Creek through funding of annual benthic macroinvertebrate surveys since 2000;

NOW, THEREFORE BE IT RESOLVED by the Carrboro Board of Aldermen that the Aldermen would like to accept this report on benthic macroinvertebrate surveys in Bolin Creek.

**Benthic Macroinvertebrate Surveys in Bolin Creek from Carrboro, North Carolina  
(August 2006)**

Prepared for:



Town of Carrboro  
301 West Main Street  
Carrboro, North Carolina 27510

Prepared by:



**Ecological Consultants**  
1014 Oxbow Crossing Road  
Chapel Hill, North Carolina 27516

October 2006

## INTRODUCTION

This study examined benthic macroinvertebrates in Bolin Creek near Carrboro, North Carolina. Benthic macroinvertebrate samples were collected from four sites in Bolin Creek designated as Confluence of Streams at Bolin Creek, SR 1777 crossing at Bolin Creek, Waterside Drive near Bolin Creek, and RR Crossing/ Estes Drive at Bolin Creek. Samples were collected during August 2006.

Ecological Consultants examined Total Taxa Richness, Total Abundance, EPT (Ephemeroptera + Plecoptera + Trichoptera) Taxa Richness, EPT Abundance and Bioclassification ratings at four sites during August 2006 within Bolin Creek in Carrboro, North Carolina. This study was initiated to determine the water quality in Bolin Creek as it traverses through Carrboro, North Carolina.

## METHODOLOGY

### Site Locations

Site locations for benthic macroinvertebrate sampling were the following:

Below Confluence of Streams at Bolin Creek - This site is located below the Hogan Farms Subdivision adjacent to the Winmore subdivision of Bolin Creek (**Photograph 1**);

SR 1777 crossing at Bolin Creek - This site is located upstream of the SR 1777 bridge crossing of Bolin Creek (**Photograph 2**);

Waterside Drive near Bolin Creek - This site is located near Waterside Drive. The site is accessed along a power line right-of-way easement adjacent to residential properties along Waterside Drive (**Photograph 3**);

RR Crossing/ Estes Drive at Bolin Creek - This site is located near the Town of Carrboro boundary line with the Town of Chapel Hill at the railroad crossing near Estes Drive. The site is accessed by an earthen path which leads into the woods along Estes Drive (**Photograph 4**).

### Field Sampling

Field sampling dates for benthic macroinvertebrates were on August 21-23, 2006. At each sampling site, water temperature, conductivity, dissolved oxygen, turbidity and pH were assessed with a Hydrolab Surveyor 4a multiprobe.

Sampling methodology followed *Standard Operating Procedures for Biological Monitoring* - 1997 for benthic macroinvertebrates. Each site was sampled by the Standard Qualitative Method which consists of two (2) kick net samples, three (3) sweep-net samples, one (1) leaf-pack sample, three (3) fine-mesh rock and/or log wash samples,

one (1) sand sample (at sandy sites), and visual collections. Benthic macroinvertebrates were separated and preserved with 70% ethanol in the field.

### **Specific Sampling Techniques**

**Kick Net** - A Kick Net (500  $\mu$  mesh) reinforced with muslin attached to wooden poles was used to sample in current areas. The net was placed on the stream bed and a 1-2 meter area upstream was disturbed to dislodge debris and organisms in the affected area. Organisms on the kick screen were picked off the Kick Net and washed down into a sieve bucket while debris was removed. Two (2) samples were taken with the Kick Net. Sampling was from different current areas in the creek.

**Sweep Net** - A Sweep Net was used to sample three (3) areas along the creek banks.

**Fine-Mesh Sampler** - A "chironomid-getter" developed by the NC Department of Environment Health and Natural Resources (NCDEHNR) was used to collect smaller benthic macroinvertebrates. The sampler was assembled of PVC piping with 200  $\mu$  nitex mesh to collect organisms off of rocks and logs. Three (3) Fine-Mesh samples were collected at each site.

**Sand Samples** - A Surber sampler (200  $\mu$  nitex mesh) was used to collect one (1) sample in sandy substrate.

**Leaf-Pack Samples** - Three (3) leaf pack samples were collected from rocks and snags in fast current areas and washed down into a sieve bucket.

**Visual Search** - Visual inspection of large rocks and logs occurred at each site.

### **Laboratory Identification**

Taxonomic quality control was maintained by the following methods:

Ecological Consultants sorted and conducted initial taxonomy of species recognizable in the field. Remaining specimens were shipped by FEDEX to the North Carolina DEM certified laboratory of Pennington and Associates.

### **Data Analysis**

Data were analyzed to calculate species richness and bioclassification according to NCDEHNR criteria. Taxa from each sample were tabulated as 1-10. Per NCDEHNR criteria >10 counts for a given species were not recorded. Tolerance Values for species were recorded; Total Taxa Richness, Total Abundance, EPT Taxa Richness and EPT Abundance were assessed at sampling sites for each sampling date. The Total Taxa Richness represented all the benthic macroinvertebrates separated into the lowest taxonomic level (usually Genus/species level of taxonomy). The EPT Taxa Richness equaled the sum of EPT taxa separated from the other benthic macroinvertebrates. The

Total and EPT Abundance values were obtained by summing all organisms and EPT individuals. Bioclassification was assessed by calculating EPT scores from organisms obtained by the Standard Qualitative Method. For the Piedmont province of North Carolina, the NCDEHNR criteria for a full scale sample EPT Taxa Richness corresponds to the following bioclassifications: Excellent >31; Good 24-31; Good-Fair 16-23; Fair 8-15; Poor 0-7. The bioclassification rating primarily reflects the influence of chemical pollutants, but can be biased by creek habitat structure. Water quality ratings or bioclassification ratings of Excellent, Good, Good-Fair, Fair and Poor for benthic macroinvertebrate samples are assigned to streams based on the EPT metric calculations.

**FINDINGS**

**Physical and Chemical Characteristics**

Water flows in Bolin Creek were normal during the August 2006 sampling period. Habitat cover including riffle zones and pools were sufficient at three of the four sites examined in Bolin Creek. However, habitat was much different at the Confluence of Streams sampling site as the substrate was dominated by mud and the riffle zone of boulders and stones were absent, apparently buried under by sediment. Also, a beaver dam was located near the downstream reach of the sampling site damming water. Water temperature, dissolved oxygen, turbidity and pH were similar for all sites except for the Confluence of streams site. Conductivity and turbidity were higher and dissolved oxygen depressed at the Confluence of Streams site. Conductivity was the lowest at the SR 1777 site.

Sites	Water Temperature (°C)	Dissolved Oxygen (mg/l)	pH pH units	Turbidity (NTU)	Conductivity (µmhos/cm)
Confluence of Streams	23.6	1.26	7.26	15.9	153
SR 1777	22.9	5.20	7.33	8.6	125
Waterside Drive	24.1	5.50	7.76	2.6	167
RR Crossing/ Estes Dr.	23.9	5.45	7.74	2.7	168

**Benthic Macroinvertebrate Surveys**

Total Taxa Richness and Abundances were greatest at the SR 1777 site (See attach spread sheet). The EPT Richness values for the Confluence of Streams, SR 1777, Waterside Drive, and RR Crossing/ Estes Drive sites were 0, 14, 8, and 8, respectively. EPT abundances were 0, 65, 36 and 29 for the Confluence of Streams, SR 1777, Waterside Drive, and RR Crossing/ Estes Drive sites, respectively. Bioclassifications ratings were

Fair for all sites, except for Confluence of the Creeks which was not rated because this site lacked the proper habitat for benthic sampling (riffle zones).

Please note that Ecological Consultants recommended the following surveys begin in Bolin Creek in our 2003 Annual Benthic Macroinvertebrate Report to the Town of Carrboro:

"Quarterly sampling for benthic macroinvertebrates at the Confluence of Streams and SR 1777 sites should be considered beginning once land is being cleared for a residential development. Also, turbidity and conductivity sampling should begin with onset of the development, during storm water events of >1 inches precipitation, to detail if storm water from developed areas is migrating into Bolin Creek. Sampling should occur within Bolin Creek and in intermittent creeks draining off of the land in this area of the watershed."

As far as I know this recommendation was never authorized.

## CONCLUSIONS

- 1). Dissolved oxygen was depressed and turbidity elevated at the Confluence of the Streams benthic sampling site.
- 2). Benthic macroinvertebrate diversity was greatest at the SR 1777 site. Benthic diversity was poor at the Confluence of the Streams site.
- 3). Habitat was much different at the Confluence of the Streams sampling site as the substrate was dominated by mud and the riffle zone of boulders and stones were absent, apparently buried under by sediment

## RECOMMENDATIONS

- 1). Continued annual benthic macroinvertebrate surveys will document the water quality of Bolin Creek as it traverses within the jurisdictional land area of the Town of Carrboro.
- 2). Again Ecological Consultants recommends the following: physico-chemistry sampling (turbidity, dissolved oxygen, pH, conductivity, water temperature) and total suspended solids should begin during storm water events of >1 inches precipitation, to detail if storm water from areas being developed above SR 1777 is migrating into Bolin Creek. Sampling should occur within Bolin Creek and in intermittent creeks draining off of the land in this area of the watershed.
  - 2a). Quarterly benthic surveys (EPT taxa richness) should be initiated at the SR 1777 site to insure habitat degradation does not spread downstream to this site.
- 3). Location of a new benthic sampling site upstream of the existing Confluence of the Streams site should be explored.
- 4). Study the extent of sediment filling in Bolin Creek near the Confluence of the Streams site by examining in stream habitat upstream and downstream from this location to access the longitudinal distance of sediment filling in the creek.

**PHOTOGRAPHS**

Photo 1. Confluence of Streams at Bolin Creek



Photo 2. Bolin Creek near SR 1777





Photo 3. Bolin Creek near Waterside Drive



Photo 4. Bolin Creek near RR Crossing/ Estes Drive



## BENTHIC MACROINVERTEBRATES COLLECTED FROM CARRBORO, NC, AUGUST 2006

SPECIES	T.V. Confluen SR177 Waterside Estes				
<b>NEMATODA</b>	<b>6</b>		<b>1</b>		
<b>MOLLUSCA</b>					
<b>Bivalvia</b>					
<b>Veneroida</b>					
Corbiculidae					
<i>Corbicula fluminea</i>	<b>6.1</b>		<b>1</b>		<b>2</b>
Sphaeriidae	<b>*8</b>				
<i>Pisidium sp. (Field Notes)</i>	<b>6.5</b>		<b>1</b>	<b>1</b>	<b>1</b>
<i>Sphaerium sp. (Field Notes)</i>	<b>7.6</b>	<b>2</b>		<b>1</b>	<b>1</b>
<b>Gastropoda</b>					
<b>Mesogastropoda</b>					
Pleuroceridae					
<i>Elimia sp.</i>	<b>2.5</b>		<b>6</b>	<b>6</b>	<b>5</b>
Viviparidae					
<i>Campeloma decisum</i>	<b>6.5</b>	<b>9</b>	<b>6</b>		
<b>Basommatophora</b>					
Planorbidae	<b>*6</b>				
<i>Helisoma anceps</i>	<b>6.2</b>	<b>2</b>	<b>1</b>	<b>1</b>	
<b>ANNELIDA</b>					
<b>Oligochaeta</b>	<b>*10</b>				
<b>Tubificida</b>					
Lumbricidae			<b>1</b>		
Naididae	<b>*8</b>				
Tubificidae w.o.h.c.	<b>7.1</b>		<b>1</b>		
<i>Spirosperma sp.</i>	<b>10</b>		<b>1</b>		
<b>Lumbriculida</b>					
Lumbriculidae	<b>7</b>		<b>1</b>		
<b>ARTHROPODA</b>					
<b>Arachnoidea</b>					
Acariformes	<b>5.5</b>		<b>1</b>		
Hygrobatidae	<b>5.5</b>				
<i>Atractides sp.</i>	<b>5.5</b>				<b>1</b>
<b>Crustacea</b>					
<b>Ostracoda</b>					<b>6</b>
<b>Cladocera</b>					
Daphnidae					
<i>Daphnia sp.</i>			<b>1</b>		
<b>Isopoda</b>					
Asellidae					
<i>Caecidotea sp.</i>	<b>9.1</b>		<b>9</b>		
<b>Amphipoda</b>					
Crangonyctidae					
<i>Crangonyx sp.</i>	<b>7.9</b>		<b>3</b>		
Hyalellidae					
<i>Hyalella azteca</i>	<b>7.8</b>	<b>1</b>	<b>3</b>		
<b>Decapoda</b>					
Cambaridae	<b>7.5</b>				
<i>Cambarus sp.</i>	<b>7.6</b>				<b>1</b>
<i>Procambarus sp. (Field Notes)</i>	<b>7</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>

SPECIES	T.V. Confluen SR177 Waterside Estes			
<b>Insecta</b>				
<b>Ephemeroptera</b>				
Baetidae (Field Noted Estes)		1		1
<i>Baetis c.f. flavistriga</i>	7	1		
Heptageniidae		7	3	
<i>Maccaffertium (Stenonema) modestum</i>	5.5	10	8	10
<i>Stenonema femoratum</i>	7.2	1		
<i>Stenacron interpunctatum</i>	6.9	10	3	1
Leptophlebiidae		1		
<b>Odonata</b>				
Aeshnidae				
<i>Boyeria vinosa</i>	5.9	2		
Coenagrionidae				
<i>Argia sp.</i>	8.2	2	2	
<i>Enallagma sp.</i>	8.9	1		
Gomphidae				
<i>Stylogomphus albistylus</i>	4.7	4		
Libellulidae				
<i>Erythemis sp.</i>		1		
<b>Plecoptera</b>				
Perlidae				
<i>Eccoptura xanthenes</i>	3.7	3		
<i>Acroneuria spp. (field observation)</i>				1
<b>Hemiptera</b>				
Nepidae				
<i>Ranatra buenoi</i>	7.8	1		
Veliidae				
<i>Microvelia sp.</i>		2	1	
<i>Rhagovelia obesa</i>		3	1	
<b>Megaloptera</b>				
Sialidae				
<i>Sialis sp.</i>	7.2	5	7	
<b>Trichoptera</b>				
Hydropsychidae (Field Noted Estes)				
<i>Cheumatopsyche sp.</i>	6.2	10	10	10
<i>Hydropsyche betteni gp.</i>	7.8	4	2	3
Hydroptilidae				
<i>Hydroptila sp.</i>	6.2		1	
Philopotamidae				
<i>Chimarra aterrima</i>	2.8	10	8	2
<i>Chimarra sp.</i>	2.8	1		
Psychomyiidae				
<i>Lype diversa</i>	4.1	1		
<b>Coleoptera</b>				
Carabidae				
		1		
Dryopidae				
<i>Helichus basalis</i>		3		
Dytiscidae				
		2		
<i>Hydroporus sp. (Field notes)</i>	8.6	2	2	1

## BENTHIC MACROINVERTEBRATES COLLECTED FROM CARRBORO, NC, AUGUST 2006

SPECIES	T.V. Confluen SR177 Waterside Estes			
Elmidae				
<i>Optioservus sp.</i>	2.4	1		
<i>Stenelmis sp.</i>	5.1	10	10	4
Psephenidae		10		
<i>Psephenus herricki</i>	2.4	10	10	3
Ptilodactylidae				
<i>Anchytarsus bicolor</i>	3.6	4		
Scirtidae		1		
<b>Diptera</b>				
Chironomidae				
<i>Ablabesmyia mallochi</i>	7.2	1		
<i>Ablabesmyia rhamphe gp.</i>	7.2	1		2
<i>Chironomus sp.</i>	9.6			2
<i>Conchapelopia sp.</i>	8.4	3		
<i>Microtendipes pedellus gp.</i>	5.5	3	1	
<i>Natarsia sp.</i>	10	2	1	
<i>Paracladopelma sp.</i>	5.5	1		
<i>Paratendipes sp.</i>	5.1	1		
<i>Polypedilum flavum (convictum)</i>	4.9	1	5	
<i>Polypedilum halterale gp.</i>	7.3	1		
<i>Polypedilum illinoense</i>	9			2
<i>Tanytarsus sp.</i>	6.8	2		
<i>Tanypus carinatus</i>		1		
<i>Thienemanniella xena</i>	5.9	3		
<i>Tribelos jucundum</i>	6.3	2		
Culicidae				
<i>Anopheles sp.</i>	8.6	1		
Tipulidae		1		
<b>TOTAL NO. OF ORGANISMS</b>	<b>29</b>	<b>188</b>	<b>77</b>	<b>62</b>
<b>TOTAL NO. OF TAXA</b>	<b>13</b>	<b>59</b>	<b>21</b>	<b>22</b>
<b>TOTAL EPT TAXA</b>	<b>0</b>	<b>14</b>	<b>8</b>	<b>8</b>
<b>TOTAL NO. OF EPT</b>	<b>0</b>	<b>65</b>	<b>36</b>	<b>29</b>
<b>Bioclassification</b>	Not Rated	Fair	Fair	Fair

## Town of Carrboro Planning Department



### **STAFF MEMORANDUM**

Date: December 5, 2006 – Corrected on 12/6/06 *WJA*  
 To: Mayor and Board of Aldermen  
 Copy: Steve Stewart, Town Manager  
 From: D. Will Autry, Environmental Planner  
 Subject: Bolin Creek Benthic Macroinvertebrate Survey Report

The purpose of this memo is to compare the results of this year's benthic macroinvertebrate survey with those of previous sampling events, to discuss the consultant's recommendations, and to present staff recommendations for ongoing surveys.

### **BACKGROUND**

The town began contracting with Ecological Consultants for benthic macroinvertebrate surveys along Bolin Creek in Carrboro in 2000. The monitoring was initiated to provide documentation of stream health and water quality variability, after being approved as an item in the town's annual Action Agenda. During the first year, sampling events were conducted quarterly at three locations. After establishing this baseline, surveys have been conducted annually from 2002-2006. Most of the sampling events have been conducted in the three original locations (1-Bolin Creek at SR 1777 [Homestead Rd.], 2-Bolin Creek near Waterside Drive, 3-Bolin Creek near RR Crossing/Estes Drive), but a fourth site at Confluence of Streams at Bolin Creek (Winmore) has been surveyed since 2003. A map of the sampling locations is attached at the end of this memo.

### **2006 REPORT**

Staff recently received the 2006 report from Ecological Consultants. The in-stream field measurements from each sampling location are listed in the table below.

Sites	Water Temperature (°C)	Dissolved Oxygen (mg/l)	pH pH units	Turbidity (NTU)	Conductivity (umhos/cm)
Confluence of Streams	23.6	1.26	7.26	15.9	153
SR 1777	22.9	5.20	7.33	8.6	125
Waterside Drive	24.1	5.50	7.76	2.6	167
RR Crossing/Estes Dr.	23.9	5.45	7.74	2.7	168

The report indicates that stream flows during the August 2006 sampling period were normal. Habitat was sufficient at three of the survey locations to allow sampling by all methods necessary

for the collection of a representative benthic macroinvertebrate sample. However, beavers have constructed a dam just downstream of the Confluence of Streams at Bolin Creek (Winmore) site. The dam is impounding a greater depth of water over the survey location, and is causing sedimentation to occur behind the dam. The dramatic change in this microhabitat resulted in a “not rated” bioclassification rating. The dam also accounted for the lower dissolved oxygen and higher turbidity measured at this location.

Results reported were similar to those of previous years, with the obvious exclusion of the site affected by the beaver dam. The rated sites all received a “Fair” bioclassification rating.

It should be noted that Ecological Consultants made the following recommendation in their 2003 report, based on the pending Winmore development:

"Quarterly sampling for benthic macroinvertebrates at the Confluence of Streams and SR 1777 sites should be considered beginning once land is being cleared for a residential development. Also, turbidity and conductivity sampling should begin with onset of the development, during storm water events of >1 inches precipitation, to detail if storm water from developed areas is migrating into Bolin Creek. Sampling should occur within Bolin Creek and in intermittent creeks draining off of the land in this area of the watershed."

This recommendation was never authorized. Although this additional monitoring data would be useful, the cost to obtain it would exceed the benefit. On the contrary, staff would recommend that the Confluence of Streams at Bolin Creek (Winmore) site be abandoned, and a new sampling location be sited upstream of the Winmore project in an area where beaver activity would be less likely to impact the site in such a way. If a new site were selected in this manner, the Winmore and Claremont construction activities would be bracketed by upstream (to be determined) and downstream (Homestead) sites for comparison, and place a more meaningful distance between the two sites. The Winmore and Homestead survey sites are very close to one another.

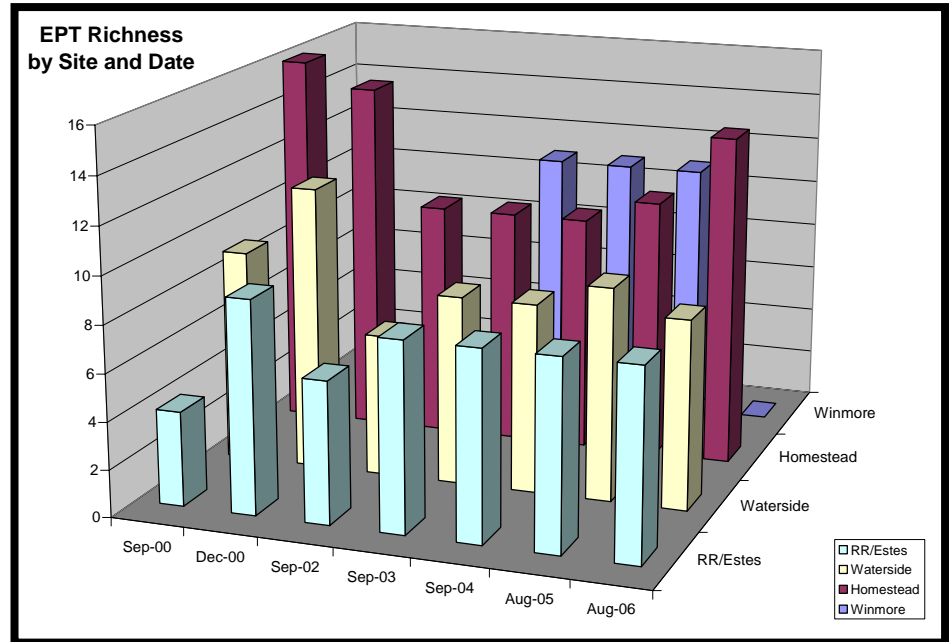
### **Trends**

As was previously mentioned, most of the Bolin benthic surveys have been conducted at the three original locations, and at the Winmore site since 2003. It should be noted that an attempt was made at sampling Bolin near Arbor Creek Court (Lake Hogan Farms) once in 2002, but flows were too low there to allow for a representative sample. The site was not revisited, but it is possible that post-drought conditions could allow for sampling there.

A brief description of each sample year is as follows.

- 2000-2001 – Quarterly sampling at 3 original sites; flows were normal during each event
- 9/2002 – Arbor Creek Ct. survey was attempted; drought had an impact on species diversity
- 9/2003 – Winmore site was added; flows were normal
- 9/2004 – Above normal flows were experienced due to some tropical storm events
- 8/2005 – Flows were somewhat low, which is normal for August
- 8/2006 – Winmore site not rated due to beaver dam; flows were normal

This chart shows the EPT Richness of all survey events. "EPT" is a group of three orders of insects (Ephemeropter [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies]) which are sensitive to pollution and are strong indicators of a stream's health. "EPT Richness" is the number of EPT taxa in a sample.



The table below shows the biclassification ratings for all sampling events.

BC Rating	9/00	12/00	3/01	6/01	9/02	9/03	9/04	8/05	8/06
Winmore	NS	NS	NS	NS	NS	Fair	Fair	Fair	NR
Homestead	Good-Fair	Good-Fair	Good-Fair	Good-Fair	Fair	Fair	Fair	Fair	Fair
Waterside	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair
RR/Estes	Poor	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair

NS = not sampled; NR = not rated

As these figures show, since recovering from the drought of 2002, excluding the sample at Winmore in 2006, the EPT richness and biclassification rating are quite static. This indicates that water quality in the sampled segment of Bolin Creek appears to be stable.



