



Crow Branch of Big Nance Ck upstream of Moulton WWTP in Lawrence County (34.4881/-87.2984)

BACKGROUND

The Crow Branch of Big Nance Creek from Muddy Fork to its source is classified for *Agriculture and Industry (A&I)* uses. As mandated, the Alabama Department of Environmental Management (ADEM) conducted a Use Attainability Analysis (UAA) study to determine if the reach could reasonably be expected to attain water quality criteria consistent with Alabama's *Fish & Wildlife (F&W)* use classification, which achieves the Clean Water Act (CWA) interim "fishable/swimmable" goal.

As part of this effort, habitat and macroinvertebrate assessments were conducted on Crow Branch at MFBN-5 on June 8, 2006.



Figure 1. Crow Branch of Big Nance Creek at MFBN-5, 13 Apr 2006.

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. The Crow Branch of Big Nance Creek is located in in the Eastern Highland Rim ecoregion (Griffith, et. al. 2001). Landuse within the watershed is primarily pasture with some forested areas. As of Sep 18, 2009, the Department has issued one NPDES permit in this watershed.

REACH CHARACTERISTICS

General observations (Table 2) and a habitat assessment (Table 3) were completed during the macroinvertebrate assessment. When compared to other reference reaches in the Eastern Highland Rim ecoregion, they give an indication of the physical condition of the site and the quality and availability of habitat. Crow Branch at MFBN-5 (Fig. 1) is a shallow, medium-gradient stream reach with a predominantly bedrock substrate. Overall habitat quality was categorized as *optimal* although a high percentage of bedrock limited in-stream habitat.

Table 1. Summary of watershed characteristics.

| Watershed Characteristics | | |
|----------------------------------|-----------------------------|----|
| Basin | Tennessee River | |
| Drainage Area (mi ²) | 10 | |
| Ecoregion ^a | 71g | |
| % Landuse | | |
| Open water | <1 | |
| Wetland | Woody | 5 |
| Forest | Deciduous | 16 |
| | Evergreen | 4 |
| | Mixed | 4 |
| Shrub/scrub | 7 | |
| Grassland/herbaceous | 2 | |
| Pasture/hay | 48 | |
| Cultivated crops | 4 | |
| Development | Open space | 6 |
| | Low intensity | 2 |
| | Moderate intensity | 1 |
| | High intensity | <1 |
| Population/km ^{2b} | 63 | |
| # NPDES Permits ^c | TOTAL | 1 |
| | Municipal Individual | 1 |

a. Eastern Highland Rim

b. 2000 US Census

c. #NPDES permits downloaded from ADEM's NPDES Management System database, 18 Sep 2009.

Table 2. Physical characteristics of Crow Branch of Big Nance Creek at MFBN-5, June 8, 2006.

| Physical Characteristics | | |
|--------------------------|----------------|-----|
| Width (ft) | 30 | |
| Canopy cover | Shaded | |
| Depth (ft) | Riffle | 0.4 |
| | Run | 1.0 |
| | Pool | 0.5 |
| % of Reach | Riffle | 3 |
| | Run | 95 |
| | Pool | 2 |
| % Substrate | Bedrock | 76 |
| | Boulder | 1 |
| | Cobble | 8 |
| | Gravel | 3 |
| | Sand | 2 |
| | Silt | 7 |
| | Organic Matter | 3 |

BIOASSESSMENT RESULTS

Benthic macroinvertebrate communities were sampled using ADEM's Intensive Multi-habitat Bioassessment methodology (WMB-I). The WMB-I uses measures of taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community. Each metric is scored on a 100 point scale. The final score is an average of the score for each metric. Metric results indicated the macroinvertebrate community to be in *poor* condition (Table 4).

Table 3. Results of habitat assessment conducted June 8, 2006.

| Habitat Assessment (% Maximum Score) | Rating |
|--------------------------------------|-----------------------------|
| Instream habitat quality | 47 Marginal (41-58) |
| Sediment deposition | 78 Optimal (> 70) |
| Sinuosity | 80 Sub-optimal (65-84) |
| Bank and vegetative stability | 68 Sub-optimal (60-74) |
| Riparian buffer | 85 Sub-optimal (70-90) |
| Habitat assessment score | 169 |
| % Maximum score | 70 Optimal (> 70) |

Table 4. Results of the macroinvertebrate bioassessment (June 8, 2006).

| Macroinvertebrate Assessment Results | | | |
|---------------------------------------|------------|----------------|---------------------|
| | Results | Scores | Rating |
| Taxa richness measures | | (0-100) | |
| # Ephemeroptera (mayfly) genera | 9 | 75 | Good (71-85) |
| # Plecoptera (stonefly) genera | 1 | 17 | Poor (16-31) |
| # Trichoptera (caddisfly) genera | 7 | 100 | Excellent (>83) |
| Taxonomic composition measures | | | |
| % Non-insect taxa | 23 | 10 | Very Poor (<24.7) |
| % Non-insect organisms | 14 | 63 | Fair (62.8-93.9) |
| % Plecoptera | 0 | 0 | Very Poor (<6.56) |
| Tolerance measures | | | |
| Beck's community tolerance index | 9 | 32 | Poor (20.2-40.7) |
| WMB-I Assessment Score | --- | 42 | Poor (24-48) |

WATER CHEMISTRY

Results of water chemistry analyses are presented in Table 5. When possible, in situ measurements and water samples are collected monthly, semi-monthly (metals), or quarterly (pesticides, herbicides (atrazine), and semi-volatile organics) during March through October to help identify any stressors to the biological communities. In-situ measurements indicated the pH to be above the 8.5 standard unit criteria for F&W during one of 13 sampling events. Stream flows were visible but not measureable during 10 of twelve sampling events. Dissolved oxygen was also documented below the 5.0 mg/L criteria for F&W during one of 13 sampling events. Individual fecal coliform counts did not exceed 58 colonies/100 ml of sample. Median total dissolved solids, specific conductance, hardness, alkalinity, chlorides, total Kjeldahl nitrogen and metals (total aluminum, manganese; dissolved arsenic, cadmium, manganese, and thallium) concentrations were elevated based on the 90th percentile of reference reaches in ecoregion 71.

CONCLUSIONS

As part of the assessment process, ADEM will review the monitoring information presented in this report, along with all other available data, to determine if the Crow Branch of Big Nance Creek should be reclassified as a *F&W* stream.

Bioassessment results indicated the macroinvertebrate community in Crow Branch of Big Nance Creek at MFBN-5 to be in *poor* condition. Results of other data collected during 2006 suggest nutrient enrichment and elevated metals to be potential causes of the deteriorated biological conditions.

Table 5. Summary of water quality data collected March-October, 2006. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL). Median, average (Avg), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value. Metals results were compared to ADEM's chronic aquatic life use criteria adjusted for hardness.

| Parameter | N | Min | Max | Median | Avg | SD |
|--------------------------------------|----|--------|------------------|--------------------|-------|-------|
| Physical | | | | | | |
| Temperature (°C) | 12 | 16.3 | 25.7 | 22.3 | 22.0 | 2.8 |
| Turbidity (NTU) | 12 | 1.9 | 4.1 | 2.8 | 3.0 | 0.8 |
| Total Dissolved Solids (mg/L) | 8 | 138.0 | 271.0 | 207.5 ^M | 199.8 | 43.7 |
| Total Suspended Solids (mg/L) | 8 | <1.0 | 4.0 | 2.5 | 2.3 | 1.2 |
| Specific Conductance (µmhos) | 12 | 232.0 | 368.0 | 329.0 ^M | 316.0 | 47.6 |
| Hardness (mg/L) | 3 | 152.0 | 234.0 | 191.0 ^M | 192.3 | 41.0 |
| Alkalinity (mg/L) | 8 | 84.7 | 184.0 | 162.8 ^M | 152.1 | 35.4 |
| Stream Flow (cfs) | 2 | 0.2 | 1.5 | 0.9 | 0.9 | 0.9 |
| Chemical | | | | | | |
| Dissolved Oxygen (mg/L) | 12 | 4.7 | 15.8 | 6.7 | 7.7 | 3.1 |
| pH (su) | 12 | 7.5 | 8.8 ^C | 7.7 | 7.8 | 0.4 |
| Ammonia Nitrogen (mg/L) | 8 | <0.015 | 0.028 | 0.008 | 0.014 | 0.010 |
| Nitrate+Nitrite Nitrogen (mg/L) | 8 | 0.073 | 11.470 | 0.202 | 1.616 | 3.983 |
| Total Kjeldahl Nitrogen (mg/L) | 8 | <0.150 | 0.899 | 0.371 ^M | 0.404 | 0.248 |
| Total Nitrogen (mg/L) | 8 | 0.359 | 11.545 | 0.651 | 2.019 | 3.856 |
| Dissolved Reactive Phosphorus (mg/L) | 8 | <0.004 | 1.446 | 0.006 | 0.189 | 0.508 |
| Total Phosphorus (mg/L) | 8 | <0.100 | 1.640 | 0.050 | 0.249 | 0.562 |
| CBOD-5 (mg/L) | 8 | 0.1 | 1.2 | 0.7 | 0.7 | 0.4 |
| Chlorides (mg/L) | 8 | 2.2 | 32.9 | 5.3 ^M | 8.3 | 10.1 |
| Atrazine (µg/L) | 1 | <0.05 | 0.05 | 0.03 | 0.03 | --- |
| Total Metals | | | | | | |
| Aluminum (mg/L) | 3 | 0.086 | 0.135 | 0.107 ^M | 0.109 | 0.025 |
| Iron (mg/L) | 3 | 0.097 | 0.185 | 0.116 | 0.133 | 0.046 |
| Manganese (mg/L) | 3 | 0.065 | 0.122 | 0.087 ^M | 0.091 | 0.029 |
| Dissolved Metals | | | | | | |
| Aluminum (mg/L) | 3 | <0.05 | <0.05 | 0.025 | 0.025 | 0.000 |
| Antimony (µg/L) | 3 | <10 | <10 | 5 | 5 | 0 |
| Arsenic (µg/L) | 3 | 12 | 14 | 13 ^M | 13 | 1 |
| Cadmium (mg/L) | 3 | <0.015 | <0.015 | 0.008 ^M | 0.008 | 0.000 |
| Chromium (mg/L) | 3 | <0.050 | <0.050 | 0.025 | 0.025 | 0.000 |
| Copper (mg/L) | 3 | <0.050 | <0.050 | 0.025 | 0.025 | 0.000 |
| Iron (mg/L) | 3 | <0.050 | <0.050 | 0.025 | 0.025 | 0.000 |
| Lead (µg/L) | 3 | <10 | <10 | 5 | 5 | 0 |
| Manganese (mg/L) | 3 | 0.05 | 0.097 | 0.067 ^M | 0.071 | 0.024 |
| ^J Mercury (µg/L) | 3 | <0.3 | 0.4 | 0.2 | 0.2 | 0.1 |
| Nickel (mg/L) | 3 | <0.05 | <0.05 | 0.025 | 0.025 | 0.000 |
| Selenium (µg/L) | 3 | <50 | <50 | 25 | 25 | 0 |
| Silver (mg/L) | 3 | <0.050 | <0.050 | 0.025 | 0.025 | 0.000 |
| Thallium (µg/L) | 3 | <10 | 18 | 11 ^M | 11 | 7 |
| Zinc (mg/L) | 3 | <0.050 | <0.050 | 0.025 | 0.025 | 0.000 |
| Biological | | | | | | |
| ^J Chlorophyll a (µg/L) | 8 | <1.00 | 3.20 | 1.34 | 1.42 | 0.97 |
| Fecal Coliform (col/100 mL) | 8 | 5 | 58 | 27 | 28 | 19 |

J=estimate; N=# samples; M=value > 90th percentile of all verified ecoregional reference reach data collected within eco-region 71; C= value exceeds established criteria for A&I use classification.

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