CURRENT BIOLOGICAL HEALTH AND WATER QUALITY

OF

THE ECONLOCKHATCHEE RIVER AND SELECTED TRIBUTARIES

January and July 1999

Surface Water Monitoring Section
Florida Department of Environmental Protection
Orlando, Florida

April 2000

BACKGROUND

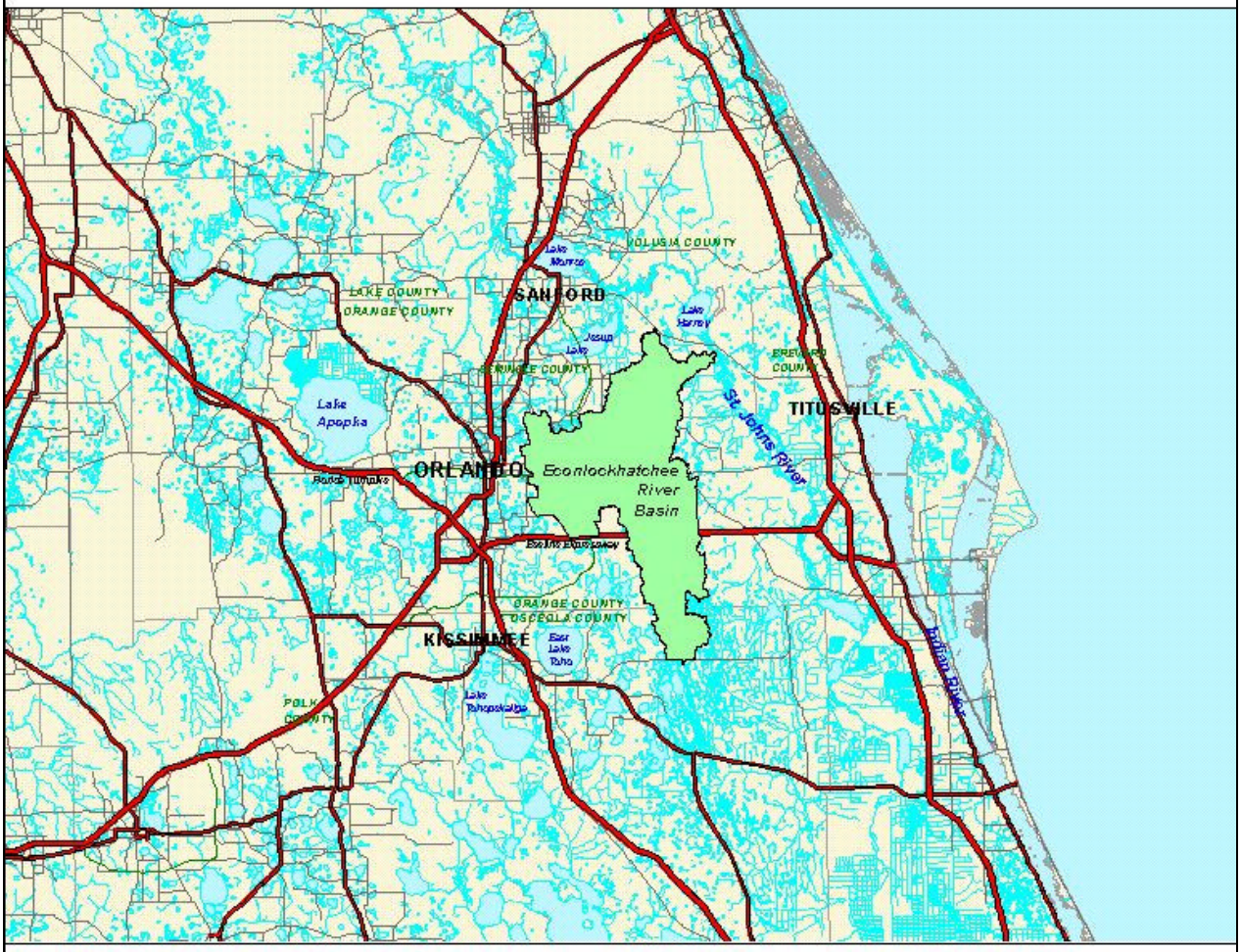
The Econlockhatchee River (often simply referred to as the “Econ”) arises from extensive cypress wetlands in the northern part of Osceola County, Florida. The first definable channel of this 36-mile-long river appears near the Osceola/Orange County line. The river flows northward through Orange County and then into Seminole County, wherein it takes a turn to the east near the city of Oviedo, flowing into the St. Johns River a short distance south of Lake Harney near the town of Geneva (Figure 1).

A number of tributaries flow into the Econlockhatchee River. Chief among these is the Little Econlockhatchee River. Unlike the largely unaltered Econ proper, the Little Econ is extensively hydrologically altered, with substantial portions of the river channel canalized and interrupted by control structures. A number of canals draining various parts of the Orlando area flow into the Little Econ. A recent study by FDEP evaluated the water quality of the Little Econ system, including two stations within the Big Econ (FDEP 1996). Other tributary streams of the Econ include Mills Creek at Chuluota, Long Branch and Bithlo Branch at Bithlo, Hart Branch, Cowpen Branch, Green Branch, Turkey Creek, Little Creek, and Fourmile Creek. The latter six are near the headwaters of the Econ. Several manmade canals also flow into the river. These include Disston Canal, which flows from Lake Mary Jane in southern Orange County, five canals operated by the Ranger Drainage District which drain the partially-developed Wedgewood subdivision in eastern Orange County, and a number of unnamed small drainages, some intermittent, in both the upper and lower stretches of the Econ.

Exclusive of the intensively urbanized Little Econ, land use in the Econ River drainage is comparatively light, at least at this point in time. Much of the upper headwaters of the river (south of the Beeline Expressway) are part of the rangeland of the Deseret Ranches, one of the largest cattle operations in the country. The next several river miles downstream are contained within St. Johns River Water Management District’s (SJRWMD) 8427-acre Hal Scott Regional Preserve and Park. Downstream of Hal Scott, the river flows near moderate-density residential developments before crossing under SR 50, and then SR 420. From here it continues northward through private ranchland and not far from several residential developments before flowing beneath SR 419 at Oviedo in Seminole County. The Little Econ joins the Big Econ just upstream of SR 419. The Econ then flows through presently undeveloped private land for a short distance before entering the 5787-acre Little-Big Econ State Forest (LBESF). There it turns to the east, and steep sand banks replace the less pronounced topography upstream. Currently, seven miles of the river are contained within the LBESF. Eventually, the state forest should encompass 15 miles of the Econ and 15,540 total acres. Beyond Snowhill Road, the river flows largely through private ranchlands, with the exception of a short stretch that is abutted on the north side by public property, and the mouth of the river, which is within the Kilbee Unit of Little-Big Econ State Forest. The entire Econ basin occupies approximately 280 mi^2.

In October 1990, the Florida Department of Environmental Regulation (now Environmental Protection) began the effort to have the Econlockhatchee River declared an Outstanding Florida Water (OFW). This would afford it the highest level of environmental protection possible. A report was issued in 1992 that detailed the rationale for this proposal, and included letters both of support and of opposition (many more of the former were received). Eventually, the river was granted OFW status. This designation included all of the Econ proper, the named tributaries, the Little Econ upstream to Michael’s Dam at Jay Blanchard Park, and the Econlockhatchee River Swamp upstream to SR 532.

Figure 1. Econlockhatchee River Basin



10 0 10 20 30 40 Miles

- Econ Basin
- Interstates
- US Routes
- Toll Roads
- State Routes
- Streams and Canals
- Water Bodies

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W E
S

Whereas FDEP's 1996 study centered on the water quality of the Little Econ River, this survey focuses on the current ecological health of the Big Econ. One of the 14 stations sampled (Econ River at SR 420) has been used by FDEP as a biological reference site for a number of years. Thus considerable background data, which indicated consistently good water quality, is available for this site. Central District biologists had monitored 4 of the other sites (Long Branch, Econ at Snowhill Road, Econ downstream of SR 419, and Little Econ just above Big Econ) at least once in recent years, but not on a regular basis. None of the other sites had been sampled by FDEP recently. Figure 2 shows the locations of the sample sites.

Water quality in the upper Econ has historically been quite good, in most respects. A number of studies (Camp, Dresser, & McKee 1992, FDEP 1992, 1994, 1996, Gerry 1983, Wanielista and Eaglin 1992) found that upstream of the Little Econ, the health of the river was good. Downstream, however, conditions tended to be less favorable, due to input from as many as 12 wastewater treatment facilities. As a result, the Econ at one point was considered the most significant source of nutrient pollution in the upper St. Johns, being responsible for algae blooms and massive fish kills in the St. Johns at Lake Harney (Gerry 1983, Hulbert 1988). Beginning in 1983, however, water quality in the Little Econ and in the Big Econ below the confluence began to recover due to improvements in and removal of most of these point sources (Brown *et al.* 1989, Hulbert 1988, Wanielista & Eaglin 1992).

STUDY DESIGN

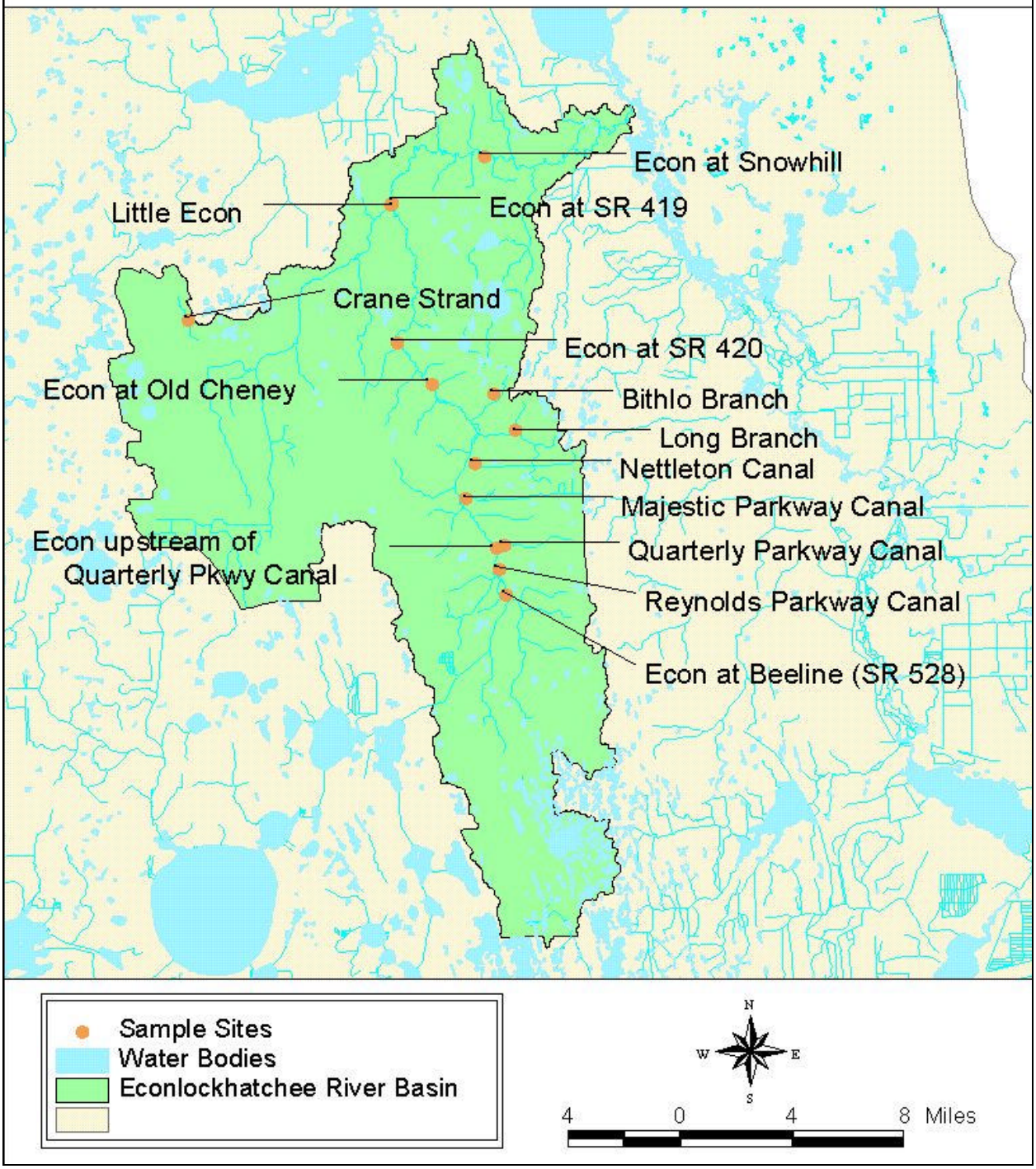
Fourteen sites were included in this study. Six are within the Econlockhatchee River proper, six are in smaller tributaries of (or canals that flow into) the Econ, one is in the Little Econ, and one site is in a tributary of the Little Econ. The sampling area extends from the Econ at SR 528 (the Beeline Expressway) downstream to the Econ at Snowhill Road. Locations of the sampling sites are shown below in Figure 2.

Sampling was carried out twice, on January 25-27, 1999 and July 13-14, 1999. Unfortunately, due to flood conditions arising from Hurricanes Floyd and Irene, it was possible to carry out biological sampling at only three of the sites in July. Water chemistry and physicochemical measurements, however, were made at all sites on both occasions.

Biological sampling was done using FDEP's biorecon assessment tool. Short for "biological reconnaissance", the biorecon is a rapid, qualitative method used to gauge the ecological health of wadeable streams in Florida. It is based on three measures of macroinvertebrate (*i.e.* small animals without backbones which can be seen with the naked eye) community health: the number of different taxa collected, the number of sensitive "EPT" species (larval mayflies, stoneflies, and caddisflies) present, and the Florida Index score generated from the sample. The Florida Index is based on the number of pollution-intolerant macroinvertebrate species present.

Macroinvertebrates are used in Florida for assessment of the ecological health of streams for several reasons. They are relatively immobile compared to other types of aquatic animals (*e.g.* fish) and therefore particularly vulnerable to localized pollution effects. Relatively long life cycles allow them to integrate various pollution effects over time. Numerous studies have demonstrated the sensitivity of various macroinvertebrate taxa to environmental perturbation. Florida state biologists have a lengthy history of using macroinvertebrates as bioindicators, and over the years have established a substantial body of knowledge and experience in evaluating stream health based on the makeup of the aquatic macroinvertebrate community. Finally, the USEPA has mandated that states monitor water quality using biology. Florida, as well as several other states, has chosen to use macroinvertebrates for such assessments.

Figure 2. Econ River Survey Sites



Twenty-three measures of water quality were made using field meters and laboratory analyses of water samples, including:

- pH
- dissolved oxygen
- specific conductance
- turbidity
- color
- alkalinity
- Secchi depth (clarity)
- algal growth potential
- total phosphorus
- nitrate/nitrite
- total Kjeldahl nitrogen
- total ammonia
- chloride
- sulfate
- biological oxygen demand
- fecal coliforms
- total coliforms
- copper
- lead
- manganese
- nickel
- zinc
- chemical oxygen demand

These measurements were made at all but one of the sites. Only fecal and total coliforms were measured at the farthest upstream site, the Econ at SR 528 (Beeline Expressway).

In addition, a thorough evaluation of habitat quality and quantity was made for each site, using FDEP's standardized protocols for stream habitat assessment (FDEP 1999).

RESULTS

Complete data tables showing the results from this survey are given in the appendices. In this section, discussion is made of each site separately (starting at the farthest point upstream), and an overall discussion follows.

Econlockhatchee River at the Beeline Expressway (SR 528)

Immediately above the SR 528 bridge, the Econ is joined by Little Creek from the east, as well as by Disston Canal less than two miles farther upstream. At the Beeline, the river hydrology has been disturbed by construction of the expressway bridges. This site was monitored for fecal and total coliforms only. Coliform bacteria levels were found to be very high in January (fecals 940 colonies/ 100mL and totals 1000 colonies/ 100mL). The fecal coliform count of 940 is a violation of Class III water quality standards. Coliform concentrations were somewhat high in July (FC 155, TC 1800). These values are most likely a reflection of the land use (cattle ranching) in the watershed upstream of this site.

(It should be noted that the names we use in this report for several of the canals sampled within Hal Scott Regional Preserve and Park were contrived by us for ease of location. In each case, we labeled the canal with the name of the nearest east-west roadway. To our knowledge, only one of the canals (Nettleton), has an actual official name. We are aware that Ranger Drainage District has alphanumeric designations for these water bodies, but we did not obtain that information.)

Reynolds Parkway Canal

Reynolds Parkway Canal is the southernmost of four canals sampled which drain the Wedgewood (a.k.a. "Rocket City") subdivision in eastern Orange County. Sampling was not actually carried out within the wide, terraced, constructed sections of this and the other canals, but rather in the small, more stream-like outflows where the canals enter the Econ River.

Data from biological sampling in January 1999 indicate that the Reynolds Parkway Canal outflow supports a healthy and well-balanced macroinvertebrate community. Twenty-one different aquatic invertebrate taxa were found in the biorecon. This number included a total of 7 mayflies and caddisflies (EPT group). The site scored 15 on the Florida Index. All three metrics passed target thresholds for healthy streams in the Florida peninsula.

All physical and chemical parameters measured were at normal levels. Nutrients and metals concentrations were low on both sampling dates. The only elevated level found was for biological oxygen demand, which was slightly to moderately high. This might have been a result of large amounts of organic matter present in the canal proper upstream. However, no depression of dissolved oxygen levels (and thus no violation of water quality standards) was detected on either sampling date.

From the standpoint of aquatic habitat, the site was rated as suboptimal, with a score of 116 out of a possible 160 points, or 73%. The lower marks here are largely a result of the absence of some habitat types, low water velocity, and smothering of some habitats by silt.

Econlockhatchee River upstream of Quarterly Parkway Canal

The next site downstream was the Econ River itself approximately 50 m upstream of Quarterly Parkway Canal. This area of the river is particularly scenic, with abundant animal and plant life. A number of large cypress trees, such as the one shown in the right-hand photo below, remain in this part of the Econ.

The Econ River in this area supports a healthy and diverse macroinvertebrate community. Biorecon sampling yielded 28 different kinds of aquatic invertebrates, including 8 EPTs (4 mayflies and 4 caddisflies). The Florida Index value was 16. The habitat assessment score was in the optimal range, with 130 out of 160 points scored.

Nutrient levels in the Econ were low, with the exception of Kjeldahl nitrogen (TKN), which was fairly high in one instance (1.4 mg in July 1999). Low concentrations of the five metals tested for (copper, lead, manganese, nickel, and zinc) were found on both dates. Coliform bacteria levels, however, were quite high in January (fecals 720/ 100mL and totals 2000/ 100mL). Neither measurement, however, indicated a violation in water quality standards for a single sampling event. Since coliform bacteria levels were low in Reynolds Parkway Canal, it is likely that the source of these high coliforms is upstream of the Beeline Expressway.

Quarterly Parkway Canal

Unlike the other canals sampled, the outflow from Quarterly Parkway Canal is short, because the river at this point curves to the east toward the end of the canal. Thus the outflow is not developed into a natural-appearing stream like the others, but instead resembles a shallow ditch. Its aquatic biological community, therefore, was not as diverse as that seen in at the other sites. It was still healthy, however, with 19 total taxa, 4 of which were mayflies and caddisflies (EPT group). The Florida Index score was 16. The most abundant macroinvertebrates in the sample were the caddisfly *Cheumatopsyche*, the amphipod *Hyalella azteca*, and the whirligig beetle *Dineutus*.

Nutrient, metal, and coliform bacteria levels were all low to moderate in the

Quarterly Parkway Canal outflow. Biological oxygen demand was somewhat high, however (1.5 mg/L), probably due to decaying organic matter in the canal.

The habitat assessment put the canal outflow in the suboptimal category (113 out of 160 possible points) due to low substrate availability and water velocity coupled with considerable silt smothering of aquatic habitats.

Nettleton Canal

Located about 1.7 miles north of Quarterly Parkway Canal, Nettleton Canal enters the Econ a short distance downstream of where a natural tributary, Cowpen Branch, flows into the river from the west. The outflow from the canal is longer than that of Reynolds, and, like the other two, forms a longer, more natural-appearing stream as it winds its way to the Econ. A power line and easement parallels the north bank of the canal, crossing the river and continuing westward toward Orlando.

This site tied with the Econ River upstream of Quarterly Parkway Canal for the highest number of different macroinvertebrates found at a given site in the survey. Twenty-eight different taxa were found in the biorecon. This number included seven from the EPT group. The Florida Index score of 19 points was also quite high. The most abundant taxa in the sample were the damselfly *Argia sedula*, the mayfly *Stenacron interpunctatum*, and the caddisfly *Cheumatopsyche*.

All water chemistry results were good at this site. All nutrients, metals, bacteria, and physical-chemical values were in the low to medium range. Habitat assessment results were also quite good, with a score of 126 out of 160 possible points (79%).

Majestic Parkway Canal

Northernmost of the four canals monitored in this survey is Majestic Parkway Canal, which lies on the northern edge of the Wedgewood development. It also did well in the biological assessment. There were 26 different macroinvertebrate taxa collected. Seven of these were from the EPT group (5 caddisflies and 2 mayflies). The Florida Index score was 18. One especially interesting macroinvertebrate collected was the larva of the caddisfly *Ceraclea spongillovorax*, which is a commensal within the freshwater sponge *Spongilla*. These sponges, which adhere as small patches or clumps on sunken logs and sticks in lower velocity darkly tannic streams, were collected at most of the sites in this area.

The results of water chemistry analyses were good on almost all counts. Low to moderate levels of nutrients, metals, and coliform bacteria were found. Physico-chemical measurements

were normal. The zinc concentration in the water, however, was quite high: 21.0 µg/L in January and 25.5 µg/L in July. Although not violations of Class III water quality standards, these levels are well above those found in 80% of Florida's streams. The source of zinc in this stream is not known at this time. Based on the biological results, however, it does not appear to have negatively affected the ecological health of this water body, at present.

The Majestic Parkway Canal outflow did well on the habitat assessment, receiving a score of 127 out of 160 possible points, or 79%.

Long Branch

This natural tributary of the Econlockhatchee arises in wetlands near the intersection of state roads 50 and 520, flowing westward into the river just south of the town of Bithlo. It has for some time been characterized by poor water quality, and is listed on the state's 303(D) list for possible TMDL study. We sampled Long Branch where it crosses under CR 13S.

The biorecon assessment rated this site as "impaired" on both sampling dates, based on the scarcity of water quality sensitive macro-invertebrate taxa that survive here. Twenty-one aquatic invertebrate taxa were found at Long Branch in January, and 32 in July. On both occasions, however, only three of these were from the water quality-sensitive EPT group. In two instances only one individual of one of these EPT taxa was found in the four sweeps. The Florida Index score was 9 in January and 8 in July. Similar results were found here with a January 1998 biorecon.

Water chemistry results were consistent with biorecon results. Turbidity, phosphorus, and ammonia levels were high on one or both sampling dates. Elevated levels of lead were found in January. Fecal and total coliform bacteria were present at high concentrations on both sampling dates.

Long Branch did relatively well on the habitat assessment, despite its substantial water quality problems. The effect of extensive silt smothering on aquatic habitats and low water velocity coupled with a scarcity of some habitat types did count against it somewhat. The habitat assessment score was 119 out of a possible 160 points, or 74%.

Bithlo Branch at Old Cheney Highway (Old SR 50)

Originating in small wetland ponds in the northern part of Bithlo, this very small, shallow, possibly intermittent tributary flows into the Econ from the northeast just downstream of where Long Branch enters. The biorecon assessment gave Bithlo Branch a marginal "healthy" rating in January, and a "suspected impaired" rating in July. Twenty and twenty-three macroinvertebrate taxa were collected, respectively. Five were from the EPT group in January, and 4 in July. The Florida Index score was 11 in January, but only 3 in July.

Water chemistry sampling yielded low to normal values for all nutrients and metals tested. Physicochemical parameters were within normal levels, also. Coliform bacteria levels, however, were high in January and extremely high in July. January sampling showed a fecal coliform concentration of 217 colonies/100mL and a total coliform concentration of 1000 colonies/100mL.These values are in approximately the 80th percentile compared to other Florida streams. These levels were substantially less, however, when compared to July, at which time both fecal and total coliform bacteria concentrations were **2600 colonies/100mL**. Both are violations of Class III water quality standards.

The habitat assessments showed different results for the two sampling dates. In January, the site received a score of 133 out of 160 points, placing it in the optimal category. In July, however, the score was a suboptimal 104, due to low flow, extensive habitat smothering, and a scarcity of aquatic habitat types.

Econlockhatchee River at Old Cheney Highway

Approximately 2 miles downstream of the confluence of Long Branch with the river is the next sampling site. Old Cheney Highway (Old SR 50) formerly crossed the river at this location, but the bridge was removed some time ago. Very recently (since this sampling was carried out in 1999), the old bridge abutments and roadway have been removed, returning the area to a topographic level similar to the surrounding floodplain (see photo at right). The actual sampling location is approximately 50 m upstream of this clearing (photo below).

The biorecon carried out in January 1999 indicated a healthy aquatic community. Of the 25 macroinvertebrate taxa collected, there were 7 EPT (4 caddisflies and 3 mayflies), The Florida Index score was 18. Thus, all three biorecon target thresholds were passed.

Water chemistry results were mixed. Although there were no extremely high values reported, some nutrient values (*i.e.* AGP, phosphorus, nitrate/nitrite, and TKN) were slightly to moderately elevated during the July sampling, as was BOD. Coliform bacteria levels were high in July, as well. Fecal coliforms were present at a concentration of 490 colonies/100 mL, and total coliforms were too numerous to count in the sample.

Habitat assessment results were good. The site scored 128 out of 160 possible points, or 80%. Less-than-optimal substrate diversity and availability, plus low water velocity and habitat smothering reduced the habitat score somewhat from what it would otherwise have been.

Econlockhatchee River at SR 420

Located just over a mile downstream of SR 50, this stretch of the river has served as a biological reference site for FDEP biologists since 1992. Biological and water chemistry samples taken over the past 8 years have consistently shown good water quality and ecological health. The results of the 1999 sampling reveal similar results.

There were 24 different macroinvertebrate taxa found in the biorecon carried out in January. Six of these were from the EPT group (3 mayflies and 3 caddisflies). The Florida Index score was 12. The most common invertebrate found in the sample was the water mite *Arrenurus*. The biorecon ranked the site as healthy.

Water chemistry results were mixed. Whereas the concentrations of the various metals sampled for were low, several nutrient levels were somewhat high in the summer sampling, as were coliform bacteria levels. AGP, total phosphorus, nitrate/nitrite, Kjeldahl nitrogen, and biochemical oxygen demand were slightly to moderately elevated in the Econ at SR 420. Fecal coliform levels were elevated on both occasions (417 and 340 colonies/100mL in winter and summer, respectively), and total coliforms were high (1500 colonies/100mL) in July.

Another parameter of concern at this site is turbidity. In the winter, the turbidity level was 12 NTU (>80th percentile). In the summer, it was 4.3 NTU, which is still somewhat above the average. A likely source of this turbidity is an unnamed tributary that flows into the river from the

west approximately 85 m upstream of the SR 420 bridge. A rapid flow of water from this stream can be seen discharging into the river at all parts of the year, often with a sediment plume apparent at the confluence. Although not a part of this survey, we sampled this tributary (pictured at right) for biology in early February 2000. Despite its apparent turbidity problems, the biorecon indicated that the macroinvertebrate community was essentially healthy. Coliform bacteria levels were low.

While carrying out the February sampling, we were approached by two different people who live in the area who expressed their concern over the effects that this tributary was having on the Econ. Both had lived in the area for some time, and indicated that the turbidity problem had been ongoing for several years. They believed that the pollution effects from the tributary had adversely affected both aquatic and terrestrial life of this area over the years. The results of our biological monitoring, however, do not readily reflect such impacts.

Little Econlockhatchee River just upstream of Econlockhatchee River

This site is located approximately 50 m upstream of where the Little Econ flows into the Big Econ near SR 419 at Oviedo. At this point, the volume of water in the Little Econ generally matches that of the Big Econ. Historically, the water quality of the Econ has shown an immediate decline downstream of this confluence due to point source inputs from wastewater treatment plants (all but one, the Iron Bridge WWTP, are now off-line) and a tremendous amount of stormwater runoff into the Little Econ from the Orlando area.

Water chemistry samples showed elevated levels of several nutrients (high algal growth potential, phosphorus, ammonia, and nitrate/nitrite) on both sampling dates, as well as copper and nickel in January. Coliform bacteria levels were higher than average for Florida streams in both winter and summer, but no violation of standards was seen. All other measured physical and chemical parameters were within normal ranges.

Biological sampling indicated that the water quality in the Little Econlockhatchee is sufficient to support a fairly robust macroinvertebrate community. The biorecon gave the stream a healthy ranking. There were 19 different taxa collected, including 3 mayflies and 5 caddisflies (EPT = 8). The Florida Index score was a respectable 18 points. Good habitat helped support this assemblage. The habitat score was 125/160 points, or 78%.

Crane Strand at University Boulevard

This canal is one of the larger tributaries of the Little Econ River. Recent FDEP sampling has indicated poor water quality in Crane Strand (FDEP 1996). In earlier days, Crane Strand existed as a stream connecting several wetland areas. Quite a few years ago, however, the stream was canalized to serve as a conduit for stormwater and effluent from two wastewater treatment plants to the Little Econ. Even though neither of the two plants discharges into Crane Strand today, the canal still receives large quantities of non-point source runoff. We sampled the canal at its approximate halfway point, at University Boulevard in Orlando.

Poor habitat and undesirable water quality combined to give meager biological results. A biorecon was performed on both dates. In each instance, the assessment rating was "impaired". Fifteen taxa were collected in January. Only one EPT organism, the mayfly *Caenis diminuta*, was present. The Florida Index score was 3. July's results were not much better. Although there were 24 macroinvertebrate taxa collected, only two were in the EPT group, and the Florida Index score was only 2.

Predictably, habitat assessment scores were also low. On both occasions, the habitat scores fell in the poor range, with 46/160 (29%) in January and 69/160 (43%) in July. Higher scores in the latter assessment were due to larger amounts of habitat (*i.e.* aquatic vegetation) present in July than in January.

Nutrient concentrations were quite high in Crane Strand Canal in winter and summer. Metals were low in all cases, with the exception of lead, which was somewhat high in January. Coliform bacteria concentrations were not especially high in January, but were extremely elevated in July, when fecal coliforms were present at a level of 1300 colonies/100 mL and total coliforms were TNTC (too numerous to count) in the sample. The fecal coliform and most likely total coliform values represent violations of water quality standards.

Econlockhatchee River at SR 419

Located a short distance downstream of the confluence with the Little Econ, this site is the first in the survey which shows the effects of the Econ's largest tributary on the main river. Beyond this point, however, there are few sources of pollution to the river, since from here to the St. Johns it flows through undeveloped land, cattle ranches, and public property.

As might be expected, nutrient levels increased substantially at this site in the Econ compared to sites farther upstream. Nutrient

input from the Little Econ was manifested in similar nutrient increases in the Big Econ. As in the Little Econ, AGP, total phosphorus, ammonia, and nitrate/nitrite measurements were all elevated. Metals and coliform bacteria concentrations, however, were within normal ranges, with the exception of the summer sampling, when total coliforms were present in the Big Econ at a level of 900 colonies/100 mL, or about the 75th percentile compared to other Florida streams.

Despite some water quality problems, the biological health of the Econ at this point appears to be good. The biorecon gave it a healthy rating. There were 23 macroinvertebrate taxa collected, 10 of which are members of the EPT group (4 mayflies and 6 caddisflies). The Florida Index rating was 18, the same as in the Little Econ River. Good habitat quality and water velocity undoubtedly contributed to the good biological results. The habitat assessment score was 129/160 points, or 81%.

Econlockhatchee River at Snowhill Road

This site, approximately 5 miles upstream from the St. Johns River, is the farthest downstream location sampled in this study. At the sample site, the north bank of the river is part of the Little-Big Econ State Forest, and the south bank is private property. From here downstream to the St. Johns, the Econ flows primarily through privately held ranchlands. The state (SJRWMD) hopes to eventually acquire a substantial portion of this land. Unlike upstream areas of the Econ, the river here winds its way to the east through relatively high, rolling sandbanks on its way toward the St. Johns.

Water chemistry values demonstrate lasting effects from upstream nutrient inputs. Nutrient analysis results here were very similar to those seen in the Big Econ near SR 419 and the Little Econ just upstream of the Big Econ, with elevated levels of AGP, phosphorus, nitrate/nitrite, and ammonia. Concentrations of metals and coliform bacteria, however, were low to moderate in the Econ at Snowhill Road.

Biorecon assessment indicated very good ecological health. Twenty-five different taxa were collected. Six of these, including 2 mayflies and 4 caddisflies, were EPT taxa. This site received the highest Florida Index score in the survey, 20 points. At least two species collected here were found nowhere else in the survey. These included the larval dragonfly *Gomphus dilatatus* and the snail *Pyrgophorus platyrachis*.

The habitat assessment score was quite good: 130/160 points, or 81%.

DISCUSSION

The results of this survey highlight several broad problems occurring within the Econlockhatchee River. High coliform bacteria levels are present throughout most of the river. This situation probably arises from more than one source. Near the headwaters, the source is almost certainly cattle operations upstream. Farther downstream, coliform concentrations are further heightened by input from septic tanks and stormwater runoff, as seen at Bithlo Branch and Crane Strand, where coliform levels indicated violations of water quality standards.

Upstream of the Little Econ, nutrient values are generally low to moderate. Downstream of the Little Econ, however, nutrients immediately become elevated, and this situation persists far downstream. Reductions in nutrients and BOD, as well as increases in dissolved oxygen levels, have occurred since 1983 (Wanielista and Eaglin 1992). However, nutrient levels remain substantially high downstream of the Little Econ. At this point in time, the only nutrient standard in the Florida Administrative Code states that nutrient levels must not cause an imbalance in flora or fauna or cause any other violations to occur. Our biological sampling did not indicate any imbalance in the macroinvertebrate community within the river proper. (The results of high nutrients are more likely to be manifested downstream in the St. Johns River and Lake Harney, where lower water velocity and greater exposure to sunlight can result in algae blooms, the proliferation of nuisance macrophytes, and possibly fish kills.)

Unfortunately, the overall ecological stability of the Econlockhatchee River itself is probably tenuous at best, given the extremely rapid pace of development in the watershed, and the water quality problems that will likely ensue.

Whereas the eastern portions of the Wedgefield development near the headwaters are served by a wastewater treatment plant, the numerous larger tracts to the west are not. Houses being built on these parcels are being served by private wells and septic systems. Given the high water table in this area, there is the potential for bacterial and/or nutrient enrichment of the shallow groundwater. This could lead to increased nutrient and bacteria levels in the canals and consequently the Econ River.

The other water quality problems we observed are more localized in nature, but they may contribute to the degradation of the Econ as a whole. These include:

- elevated zinc levels in Majestic Parkway Canal (though far below violation concentrations)
- overall very poor water quality in Long Branch
- turbidity from unnamed tributary near SR 420

The source of the high zinc concentrations in the canal is not known. However, it does not appear to have had any obvious negative effect on the health of the river, since this was the only site in this survey at which zinc concentrations were especially high, and the health of the macroinvertebrate community present in the canal itself was quite good.

As mentioned earlier, Long Branch is being evaluated for an intensive TMDL (total maximum daily load) study, which should further identify the sources of pollution in the watershed, and hopefully elucidate remediation alternatives.

We think that further study is needed regarding the effect of the unnamed tributary near SR 420 on the health of the Econ, and the source(s) of degradation. Given this information, recommendations for the improvement of the situation should become evident.

SUGGESTIONS

We offer the following general and specific suggestions for the enhancement of water quality in the Econlockhatchee River system.

1. Slow the pace of development in the watershed. A large component of the water quality problem in the Econ drainage is due to increased urbanization of the watershed and the non-point source runoff that inevitably follows. County and regional planners should seek to decelerate the pace at which development is proceeding in this area.
2. Retrofit or repair aging and/or malfunctioning stormwater retention and sewage disposal systems.
3. Cattle ranchers need to reduce their herds' impact on the river's water quality. Best management practices require fencing off stream corridors to prevent access by cattle.
4. Restoration of the stream channel in altered areas of the watershed. This would aid in water quality improvement and increase habitat for aquatic organisms.

REFERENCES

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For more information please contact Dana Denson or Eric Pluchino, Surface Water Monitoring Section, Florida Dept. of Environmental Protection, 3319 Maguire Blvd., Suite 232, Orlando, FL 32803. Telephone (407) 894-7555, SC 325-2355, email dana.denson@dep.state.fl.us or eric.pluchino@dep.state.fl.us.

This report is available via the internet at the following website: http://www.dep.state.fl.us/water/Slerp/bio/

Appendix 1. Econ Survey Water Quality Data

SITE	STORET	LATITUDE			LONGITUDE			BIORECON		TAXA	EPT	FI	HABITAT SCORE
								ranking	parameters	number	number	value	max 160
January-99		D	M	S	D	M	S		passed				
Econ River at SR 528 (Beeline)	20010301	28	27	5	81	6	30	*	*	*	*	*	*
Reynolds Parkway canal outflow	20010345	28	27	54	81	6	42	healthy	3	21	7	15	116
Econ upstream of Quarterly Pkwy canal	20010346	28	28	32	81	6	49	healthy	3	28	8	16	130
Quarterly Parkway canal outflow	20010347	28	28	37	81	6	32	healthy	3	19	4	16	113
Majestic Parkway canal outflow	20010349	28	31	10	81	7	29	healthy	3	26	7	18	127
Nettleton Canal outflow	20010348	28	30	6	81	7	50	healthy	3	28	9	20	126
Long Branch at CR 13	20010384	28	32	11	81	6	2	*impaired*	1	21	3	9	119
Bithlo Branch at Old SR 50	20010350	28	33	18	81	6	33	healthy	3	20	5	11	133
Econ River at Old Cheney Hwy	20010356	28	33	40	81	8	57	healthy	3	25	7	18	128
Econ River at SR 420	20010129	28	34	58	81	10	7	healthy	3	24	6	12	124
Econ River just downstream of SR 419	20010130	28	39	18	81	10	12	healthy	3	23	10	18	129
Little Econ just above confluence w/Econ	20010041	28	39	16	81	10	14	healthy	3	19	8	18	125
Econ River at Snowhill Road	20010300	28	40	40	81	6	53	healthy	3	25	6	20	130
Crane Strand at University Blvd.	20010357	28	35	50	81	17	30	*impaired*	0	15	1	3	46
July-99													
Econ River at SR 528 (Beeline)	20010301	28	27	5	81	6	30	*	*	*	*	*	*
Reynolds Parkway canal outflow	20010345	28	27	54	81	6	42	*	*	*	*	*	*
Econ upstream of Quarterly Pkwy canal	20010346	28	28	32	81	6	49	*	*	*	*	*	*
Quarterly Parkway canal outflow	20010347	28	28	37	81	6	32	*	*	*	*	*	*
Majestic Parkway canal outflow	20010349	28	31	10	81	7	29	*	*	*	*	*	*
Nettleton Canal outflow	20010348	28	30	6	81	7	50	*	*	*	*	*	*
Long Branch at CR 13	20010384	28	32	11	81	6	2	*impaired*	1	32	3	8	98
Bithlo Branch at Old SR 50	20010350	28	33	18	81	6	33	*suspect*	2	23	4	3	104
Econ River at Old Cheney Hwy	20010356	28	33	40	81	8	57	*	*	*	*	*	*
Econ River at SR 420	20010129	28	34	58	81	10	7	*	*	*	*	*	*
Econ River just downstream of SR 419	20010130	28	39	18	81	10	12	*	*	*	*	*	*
Little Econ just above confluence w/Econ	20010041	28	39	16	81	10	14	*	*	*	*	*	*
Econ River at Snowhill Road	20010300	28	40	40	81	6	53	*	*	*	*	*	*
Crane Strand at University Blvd.	20010357	28	35	50	81	17	30	*impaired*	1	24	2	2	69
SITE								BIOLOGY					

An asterisk (*) indicates that no measurement was made for this parameter, or the results are not available.
Note: Due to flood conditions, appropriate biological sampling was impossible at all but three sites in July 1999.

Appendix 1. Econ Survey Water Quality Data

SITE	pH	DO	COND.	TURB	COLOR	ALK	SECCHI	AGP	TP	NO_2NO_3	TKN
	SU	mg/L	umhos/cm	NTU	PT-CO	mg/L	m	mg dry wt/L	mg/L	mg/L	mg/L
January-99											
Econ River at SR 528 (Beeline)	*	*	*	*	*	*	*	*	*	*	*
Reynolds Parkway canal outflow	6.8	8.5	161	2.2	100	60	>0.7	0.151	0.015	0.008	0.36
Econ upstream of Quarterly Pkwy canal	6.6	6	155	1.3	150	37.9	>0.7	0.81	0.06	0.008	0.73
Quarterly Parkway canal outflow	7.2	7.9	239	2	60	103	>0.1	0.049	0.015	0.018	0.33
Majestic Parkway canal outflow	6.5	7.9	90	1.2	100	22.1	>0.15	0.076	0.015	0.007	0.39
Nettleton Canal outflow	6.9	8.2	267	1.1	60	45.3	>0.2	0.097	0.015	0.029	0.49
Long Branch at CR 13	7.3	5.5	365	18	150	77.9	0.4	4	0.24	0.056	0.83
Bithlo Branch at Old SR 50	6.9	6.4	199	3.4	100	35.8	>0.4	0.126	0.016	0.02	0.47
Econ River at Old Cheney Hwy	7.1	6.5	249	1.4	60	51.6	>1.0	0.219	0.033	0.009	0.59
Econ River at SR 420	7	6.5	197	12	150	42.1	0.5	0.74	0.04	0.01	0.61
Econ River just downstream of SR 419	7.2	7.2	217	3	100	52.6	1.3	12.66	0.07	0.28	0.51
Little Econ just above confluence w/Econ	7.3	7	220	3.5	100	54.8	1.1	23.59	0.09	0.37	0.51
Econ River at Snowhill Road	7.3	7.2	368	2.9	80	56.9	>1.0	20.21	0.08	0.43	0.59
Crane Strand at University Blvd.	7.2	8.2	223	2.6	60	79	>0.2	15.936	0.18	0.2	0.47
July-99											
Econ River at SR 528 (Beeline)	*	*	*	*	*	*	*	*	*	*	*
Reynolds Parkway canal outflow	7.4	6.3	127	3.4	25	43.2	>0.6	0.43	0.03	0.036	0.51
Econ upstream of Quarterly Pkwy canal	5.6	4.8	65	1.45	300	3	0.4	5.88	0.07	0.02	1.4
Quarterly Parkway canal outflow	6.8	4	103	2.8	25	41.1	0.8	4.88	0.05	0.042	0.61
Majestic Parkway canal outflow	6.9	5.2	98	1.62	75	14.1	>0.2	0.139	0.025	0.049	0.78
Nettleton Canal outflow	7.3	5.9	290	1.38	40	46.2	>0.6	0.255	0.024	0.025	0.58
Long Branch at CR 13	7.3	4.7	2610	6.4	40	53	0.4	6.53	0.11	0.11	0.37
Bithlo Branch at Old SR 50	7.3	3.8	730	17	80	33	>0.1	5.01	0.05	0.05	0.67
Econ River at Old Cheney Hwy	6.6	4.4	980	2.8	300	16.1	0.5	7.98	0.1	0.09	1.4
Econ River at SR 420	7.1	5.1	1060	4.3	200	24	0.7	8.52	0.1	0.09	1.3
Econ River just downstream of SR 419	7.5	4.8	1470	4.2	50	34.1	0.8	11.37	0.11	0.12	1
Little Econ just above confluence w/Econ	7.3	4.8	1760	3.4	100	43.2	0.8	11.26	0.14	0.15	0.73
Econ River at Snowhill Road	7.1	4.6	1700	5.5	150	33.1	0.9	10.63	0.12	0.13	0.98
Crane Strand at University Blvd.	7.5	8.6	2630	2.8	30	86.3	>2	14.74	0.15	0.18	0.5
SITE	pH	DO	COND.	TURB	COLOR	ALK	SECCHI	AGP	TP	NO_2NO_3	TKN

An asterisk (*) indicates that no measurement was made for this parameter, or the results are not available.

Appendix 1. Econ Survey Water Quality Data

SITE	TOT NH_3	Cl^-	$SO4^-$	BOD5	fecal col	total col	Cu	Pb	Mn	Ni	Zn	COD
	mg/L	mg/L	mg/L	mg/L	#/100 mL	#/100 mL	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
January-99												
Econ River at SR 528 (Beeline)	*	*	*	*	940	1000	*	*	*	*	*	*
Reynolds Parkway canal outflow	0.012	15	3.9	1.5	42	133	0.4	0.23	4.8	0.72	6	42
Econ upstream of Quarterly Pkwy canal	0.019	21	5.4	1.3	720	2000	0.4	0.2	4.38	0.69	6	87
Quarterly Parkway canal outflow	0.03	15	4.1	1.5	82	133	0.4	0.12	4.65	1.3	11.5	67
Majestic Parkway canal outlfow	0.02	12	6.7	1	14	150	0.4	0.11	3.32	0.6	21	53
Nettleton Canal outflow	0.03	49	17	1	5	37	1.6	0.11	4.13	1.1	9.4	53
Long Branch at CR 13	0.06	45	27	1.5	150	733	1.5	1.77	18.5	2.1	15.3	76
Bithlo Branch at Old SR 50	0.015	33	9.7	1	217	1000	0.4	0.34	6.9	0.69	6.3	49
Econ River at Old Cheney Hwy	0.012	33	17	1	300	533	0.4	0.22	11	0.94	6	58
Econ River at SR 420	0.016	25	13	1	417	500	1.7	0.67	6.03	0.93	6	69
Econ River just downstream of SR 419	0.02	26	12	1	110	150	1.5	0.4	9.3	0.98	6	56
Little Econ just above confluence w/Econ	0.019	25	13	1	134	433	3.7	0.39	8.77	5.2	6	58
Econ River at Snowhill Road	0.04	57	27	1	76	250	1.4	0.28	7.97	1.3	10.9	51
Crane Strand at University Blvd.	0.09	16	11	1.1	39	400	1.7	1.17	16.4	1.3	6	38
July-99												
Econ River at SR 528 (Beeline)	*	*	*	*	155	1800	*	*	*	*	*	*
Reynolds Parkway canal outflow	0.015	12	3.1	1.7	73	267	1.7	0.38	8.11	1	8	10
Econ upstream of Quarterly Pkwy canal	0.04	9.4	1.5	1.2	270	733	0.58	0.57	10	1	8	120
Quarterly Parkway canal outflow	0.04	7.1	2.9	1.1	30	500	0.5	0.25	7.42	1	16.4	23
Majestic Parkway canal outflow	0.04	13	7.4	1.1	55	500	0.5	0.25	7.3	1	25.5	46
Nettleton Canal outflow	0.011	53	14	1.5	55	400	0.6	0.25	3.54	1	12.5	13
Long Branch at CR 13	0.06	18	50	1.1	360	1300	0.97	0.53	7.53	1	8	37
Bithlo Branch at Old SR 50	0.04	38	8.7	1.4	2600	2600	0.81	0.59	16.7	1	13.6	30
Econ River at Old Cheney Hwy	0.04	13	2.4	1.3	490	TNTC	0.61	0.57	14	1	15.9	110
Econ River at SR 420	0.04	14	3	1.4	340	1500	1.2	0.65	13.6	1	8	120
Econ River just downstream of SR 419	0.06	18	8.2	1.2	91	900	1.5	0.52	11.2	1	8	56
Little Econ just above confluence w/Econ	0.05	21	11	1.2	150	500	1.9	0.47	10.6	1	19.2	30
Econ River at Snowhill Road	0.07	24	11	1.2	62	600	1.7	0.54	10.1	1	8	53
Crane Strand at University Blvd.	0.05	24	14	1	1300	TNTC	2.1	0.49	7.39	1	12.8	20
SITE	**TOT NH_3**	**Cl^-**	**$SO4^-$**	**BOD5**	**FC**	**TC**	**Cu**	**Pb**	**Mn**	**Ni**	**Zn**	**COD**

An asterisk (*) indicates that no measurement was made for this parameter, or the results are not available.

Appendix 2. Master Taxa List Econ River 1

Site code: REYN = Reynolds Parkway Canal, ECQR = Econ upstream of Quarterly Parkway Canal, QUAR = Quarterly Parkway Canal, MAJE = Majestic Parkway Canal, NETL = Nettelton Canal, LONG = Long Branch, BITH = Bithlo Branch, ECOC - Econ at Old Cheney Hwy, EC42 = Econ at SR 420, EC41 = Econ at SR 419, LTEC = Little Econ, ECSH = Econ at Snowhill, and CRST = Crane Strand

Abundance code: R = rare (1-3), C = common (4-10), A = abundant (11-99), D = dominant (100 or >), P = present (colonial organism)

JANUARY 1999 BIORECONS

site ->	REYN	ECQR	QUAR	MAJE	NETL	LONG	BITH	ECOC	EC42	EC41	LTEC	ECSH	CRST
INSECTA													
COLEOPTERA													
Cyphon sp.							R						
Dineutus sp.	R	R	A				R				R	R	
Dubiraphia vittata					R	R				R			
Helochares sp.													
Microcylloepus sp.		R		C	R		R						
Pelonomus sp.													
Peltodytes sp.													C
Scirtes sp.					R								
Stenelmis sp.	R	R		R	R	R	C	C	C	C		C	
Uvarus sp.													
DIPTERA													
Ceratopogonidae	R	R	R	R		R			R				R
Chironomidae	C	C	C	A	A	C	A	C	C	A	C	A	A
Rheotanytarsus sp.				R	R		R					R	
Simulium sp.				R			A			R		R	
Stenochironomus sp.		R	R	A	C	R	A	R				R	
Tipulidae									C				
EPHEMEROPTERA													
Acerpenna pygmaea	R			C	R	R	A	C	C	C			
Baetidae											C	A	
Caenis sp.	R				R	C	C						C
Callibaetis sp.		R											
Choroterpes basalis		R					R						

Appendix 2. Master Taxa List Econ River 2

	REYN	ECQR	QUAR	MAJE	NETL	LONG	BITH	ECOC	EC42	EC41	LTEC	ECSH	CRST
Labeobaetis sp.	R									C			
Leptophlebiidae													
Stenacron interpunctatum		R	R	R	A			C	C	R	R		
Stenonema exiguum	A	C	R					C	C	C	C	C	
HEMIPTERA													
Belostoma sp.													
Gerridae													
Mesoveliidae	R												
Ranatra sp.		R						R				R	
Veliidae													
LEPIDOPTERA													
Pyralidae		R				R							
MEGALOPTERA													
Corydalus cornutus	C	C			R			R		R		R	
ODONATA													
Argia fumipennis				C									
Argia moesta								R	C	R	R		
Argia sedula	R		C	C	A	C		R		C		C	C
Argia tibialis		C						R					
Boyeria vinosa									R		R		
Calopteryx maculata			R	R	R	R	R	R					
Enallagma cardenium		C											
Enallagma pollutum													
Enallagma sp.				R	R	C	C			R			C
Epitheca princeps regina									R			R	
Gomphus dilatatus												R	
Gomphus minutus		R											
Gomphus sp.			R	R					R				
Hetaerina titia										R	R		
Ischnura posita													
Ischnura sp.													
Libellula incesta		R											

Appendix 2. Master Taxa List Econ River 3

	REYN	ECOR	QUAR	MAJE	NETL	LONG	BITH	ECOC	EC42	EC41	LTEC	ECSH	CRST
Libellulidae													
Macromia taeniolata											R		
Macromia sp.	R	R	R		R			R	R				
Nasiaeschna pentacantha						R							
Neurocordulia alabamensis	R			C	R	R		R					
Orthemis ferruginea													
Pachydiplax longipennis						R							
Stylurus plagiatus													
TRICHOPTERA													
Ceraclea spongillovorax				R									
Cernotina sp.									R				
Cheumatopsyche sp.	C		A	A	C	R	C	C	C	C	C		
Chimarra sp.	C		R		A					C	R	A	
Hydropsyche sp.				A									
Hydropsyche sparna	C	R								R	R	A	
Hydroptila sp.				R									
Nectopsyche exquisita		R						C			R		
Nectopsyche sp.					R								
Neureclipsis crepuscularis								R				R	
Nyctiophylax sp.		R								R			
Oecetis georgia								R				C	
Oecetis sp.							R			R			
Oecetis sp. A													
Triaenodes ignitus									R	R	R		
Triaenodes pernaheleb					C								
Triaenodes sp.		R		C									
MOLLUSCA													
BIVALVIA													
Corbicula fluminea				C	R			C	R				C
Elliptio sp.	R			R							R		
Eupera cubensis													
Musculium sp.													

Appendix 2. Master Taxa List Econ River 4

	REYN	ECQR	QUAR	MAJE	NETL	LONG	BITH	ECOC	EC42	EC41	LTEC	ECSH	CRST
Musculium partumeium													
Pisidiidae			R			R			R			R	
Sphaeriidae													
Sphaerium occidentale													
GASTROPODA													
Ancylidae			R		R			R					R
Hydrobiidae									C	C	C	R	
Melanoides tuberculata													C
Micromenetus dilatatus avus										R			
Physella hendersoni hendersoni													
Physella sp.													
Planorbella duryi													
Pseudosuccinea columella			R									R	R
Pyrgophorus platyrachis												R	
CRUSTACEA													
DECAPODA													
Astacidae		R	R	R	R	R		R					R
Palaemonetes kadiakensis					R								
Palaemonetes paludosus	R	R	C		R			R	R	C	C	C	R
AMPHIPODA													
Gammarus sp.						C	R					C	
Hyalella azteca	R	R	A	R	R	C	R	R	R	C	R		C
ISOPODA							R						
ANNELIDA													
HIRUDINEA								R					C
Gloiobdella elongata													
OLIGOCHAETA													
Lumbriculidae				R									

Appendix 2. Master Taxa List Econ River 5

	REYN	ECQR	QUAR	MAJE	NETL	LONG	BITH	ECOC	EC42	EC41	LTEC	ECSH	CRST
Naididae							R	R		C			
Tubificidae		R	R			C	C	A	C			R	R
OTHER GROUPS													
PORIFERA	P	P							P				
Spongilla				P	P								
TROMBIDIFORMES		R		R		R		C	A		R	C	
Krendowskia sp.	R												
Neumania sp.					R								
PLATYHELMINTHES													
Dugesia sp.									R				

111 total taxa.

Appendix 2. Master Taxa List Econ River 6

Note: Actual numbers of each taxon are given for the Stream Condition Index (SCI), which is semi-quantitative.

	JULY 1999 BIORECONS			**JULY 1999 SCIs**		
	LONG BRANCH	BITHLO BRANCH	CRANE STRAND	LONG BRANCH	BITHLO BRANCH	CRANE STRAND
INSECTA						
COLEOPTERA						
Cyphon sp.						
Dineutus sp.	R	R		1	1	
Dubiraphia vittata	C	R		3	3	1
Helochares sp.		R				
Microcylloepus sp.	R	C		15	5	
Pelonomus sp.		R				
Peltodytes sp.			C			1
Scirtes sp.						
Stenelmis sp.	C	A		2	59	
Uvarus sp.			R			
DIPTERA					1	
Ceratopogonidae	R				1	
Chironomidae	A	C	A	22 (10 species)	12 (7 species)	22 (8 species)
Rheotanytarsus sp.						
Simulium sp.						
Stenochironomus sp.	R	R				
Tipulidae	R	R			1	
EPHEMEROPTERA						
Acerpenna pygmaea						
Baetidae	R	R	R			
Caenis sp.	C	R	A		1	6
Callibaetis sp.						
Choroterpes basalis		C				
Labeobaetis sp.						
Leptophlebiidae					7	
Stenacron interpunctatum						
Stenonema exiguum						

Appendix 2. Master Taxa List Econ River 7

	LONG BRANCH	BITHLO BRANCH	CRANE STRAND	LONG BRANCH	BITHLO BRANCH	CRANE STRAND
HEMIPTERA						
Belostoma sp.			R			
Gerridae	R					
Mesoveliidae						
Ranatra sp.						
Veliidae	R					
LEPIDOPTERA						
Pyralidae	C		R			
MEGALOPTERA						
Corydalus cornutus						
ODONATA						
Argia fumipennis						
Argia moesta						
Argia sedula	R		A	1		8
Argia tibialis						
Boyeria vinosa						
Calopteryx maculata	R					
Enallagma cardenium		R				2
Enallagma pollutum						3
Enallagma sp.	R		A			
Epitheca princeps regina						
Gomphus dilatatus						
Gomphus minutus						
Gomphus sp.						
Hetaerina titia						
Ischnura posita	R					1
Ischnura sp.			R			
Libellula incesta						
Libellulidae			R			
Macromia taeniolata						
Macromia sp.						
Nasiaeschna pentacantha						

Appendix 2. Master Taxa List Econ River 8

	LONG BRANCH	BITHLO BRANCH	CRANE STRAND	LONG BRANCH	BITHLO BRANCH	CRANE STRAND
Neurocordulia alabamensis						
Orthemis ferruginea			R			
Pachydiplax longipennis						
Stylurus plagiatus			R			
TRICHOPTERA						
Ceraclea spongillovorax						
Cernotina sp.						
Chaumatopsyche sp.	A	R		20		
Chimarra sp.						
Hydropsyche sp.						
Hydropsyche sparna						
Hydroptila sp.						
Neotopsyche exquisita						
Neotopsyche sp.						
Neureclipsis crepuscularis						
Nyctiophylax sp.						
Oecetis georgia						
Oecetis sp.						
Oecetis sp. A					1	
Triaenodes ignitus						
Triaenodes perna/hebo						
Triaenodes sp.						
MOLLUSCA						
BIVALVIA						
Corbicula fluminea		R	A	9		4
Elliptio sp.						
Eupera cubensis	R					
Musculium sp.		R				
Musculium partumeium					14	
Pisidiidae	C		R			
Sphaeriidae				10		
Sphaerium occidentale						15

Appendix 2. Master Taxa List Econ River 9

	LONG BRANCH	BITHLO BRANCH	CRANE STRAND	LONG BRANCH	BITHLO BRANCH	CRANE STRAND
GASTROPODA						
Ancylidae				3 (3 species)		
Hydrobiidae	R			2		
Melanoides tuberculata			A			7
Micromenetus dilatatus avus	R	R		1		
Physella hendersoni hendersoni		R				
Physella sp.	R		C			
Planorbella duryi			C			
Pseudosuccinea columella	R					
Pyrgophorus platyrachis						
CRUSTACEA						
DECAPODA						
Astacidae	C	R	C	1	15	
Palaemonetes kadiakensis						
Palaemonetes paludosus	R					
AMPHIPODA	R	A			10	
Gammarus sp.						
Hyalella azteca	C		A	4		78
ISOPODA		C	R			
ANNELIDA						
HIRUDINEA			C			
Gloiobdella elongata				1		1
OLIGOCHAETA						
Lumbriculidae						
Naididae	R					
Tubificidae	C	C	C	4		1

Appendix 2. Master Taxa List Econ River 10

	LONG BRANCH	BITHLO BRANCH	CRANE STRAND	LONG BRANCH	BITHLO BRANCH	CRANE STRAND
OTHER GROUPS						
PORIFERA						
Spongilla						
TROMBIDIFORMES	A	R	D			
Krendowskia sp.						
Neumania sp.						
PLATYHELMINTHES						
Dugesia sp.						