

**ANNUAL REPORT**

**CALENDAR YEAR 2004**

**IMPLEMENTATION OF MITIGATION ACTION PLAN  
FOR LEASE OF LAND PARCEL ED-1  
ON THE OAK RIDGE RESERVATION  
OAK RIDGE, TENNESSEE**

**June 2005**

**U.S. Department of Energy  
Oak Ridge Office  
Oak Ridge, Tennessee**

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## LIST OF ACRONYMS

|       |  |
|-------|--|
| BI    | Biotic Index   |
| BMAP  | Biological Monitoring and Abatement Program          |
| CG    | Collector/gathers                                    |
| CROET | Community Reuse Organization of East Tennessee       |
| DOE   | U.S. Department of Energy                            |
| EA    | Environmental Assessment                             |
| EPT   | Ephemeroptera – Plecoptera – Tricoptera              |
| FC    | Filterer/Collectors                                  |
| FFG   | Functional Feeding Groups                            |
| FONSI | Finding of No Significant Impact                     |
| MAP   | Mitigation Action Plan                               |
| NEPA  | National Environmental Policy Act                    |
| ORNL  | Oak Ridge National Laboratory                        |
| P     | Predators  |
| PI    | Piercers   |
| SC    | Scrapers   |
| SH    | Shredders  |
| TDEC  | Tennessee Department of Environment and Conservation |
| TV    | Tolerance Values                                     |
| TWRA  | Tennessee Wildlife Resources Agency                  |

## 1. EXECUTIVE SUMMARY

In preparation for the transfer of Horizon Center, formerly Parcel ED-1, to the Community Reuse Organization of East Tennessee (CROET), an environmental review committee was established in 2002 to evaluate the Mitigation Action Plan and determine its effectiveness. The committee recommended an environmental investigation for 2004 that included monitoring of the Tennessee dace (*Phoxinus tennesseensis*), benthic macroinvertebrates at selected sites, birds, amphibians and reptiles, and inspection of sensitive sites. This report is in compliance with the committee's recommendations.

Fish surveys were restricted to Dace Branch where the state protected Tennessee dace has been monitored. While the population was low, it was equal to pre-lease conditions.

As in other years, some bird species were reported that had not been observed in previous years of monitoring. Additionally, some species that were observed in previous surveys were not observed in this survey. The data suggest a healthy bird community during this sampling period. At least 22 bird species listed by state and federal agencies as being in need of protection were found to be using the Horizon Center in 2004.

Macroinvertebrate communities in East Fork Poplar Creek were surveyed at stations upstream and downstream from development activities. The data indicate shifts in macroinvertebrate community structures within the Horizon Center and the control stream toward higher concentrations of Ephemeroptera, Plecoptera and Trichoptera and lower concentrations of chironomids. This is indicative of either better water quality or lower concentrations of natural organic debris in the streams for the year 2004.

There were no changes in the ecology of sensitive areas. The numbers of Canadian yellow lilies (*Lilium canadense*) and golden seals (*Hydrastis canadensis*) were approximately the same as in 2003.

Cultural resources were protected and maintained.

No development activities were underway during 2004 and no environmental permits were required.

## 2. INTRODUCTION

The U. S. Department of Energy (DOE) executed a lease for the 957.16 acre Parcel ED-1 of the Oak Ridge Reservation to the Community Reuse Organization of East Tennessee (CROET) for development of an industrial park (now known as Horizon Center) in January 1996. The lease subsequently became effective in April 1998. The lease was preceded by a National Environmental Policy Act (NEPA) Environmental Assessment (EA) (DOE 1996A) resulting in a mitigated Finding of No Significant Impact (FONSI) and the action was accompanied by a Mitigation Action Plan (MAP) (DOE 1996B).

The FONSI specified that mitigation measures be implemented to meet the objectives of preventing significant adverse impacts to ecological resources, floodplains, wetlands, water resources, and historic and archaeological resources. These measures were: (1) excluding areas of the Horizon Center from disturbance and development, and (2) conducting surveys and monitoring of industrial development areas prior to disturbance, during construction, and during facilities operations.

In December 1997, DOE published a report (DOE 1997) that documented baseline conditions from June 1996 through September 1997 and established monitoring sites. In December 1998, DOE published a report (DOE 1998) of progress toward meeting these objectives during the site master planning and early construction phases. Additionally, the DOE (1998) report addressed least environmentally damaging alternatives for development, pre-construction surveys, and monitoring during the first phase of construction of Horizon Center.

A plan was developed that would meet site development goals while adhering to the NEPA commitments. Master planning of the site relied heavily on several ecological studies and resulting recommendations for avoiding state or federally listed species and critical or unique habitats, and for minimizing impact to stream and floodplain crossings. The site master plan was accepted by DOE and subsequently implemented.

In preparation for the transfer of Horizon Center to CROET, DOE appointed a Peer Review Team to review and, if appropriate, revise the existing MAP (DOE 1997B). The recommended revisions were incorporated in an EA Addendum (DOE 2003A) Mitigated FONSI (DOE 2003B) signed on April 2, 2002. These were reviewed in the 2002 Annual Report (DOE 2003).

The revised MAP (DOE 2003C) included the following requirements. Each of these was accomplished in 2002, 2003, and 2004.

- Inspection of sensitive areas within Natural Area (3 times per year during December-January; April-June; and September-October)
  - Perimeter boundary of the Natural Area
  - Cave
  - Sinkholes
  - Canebrakes

- Springs
  - Wetlands
  - Rare species locations
  - East and west corridors
  - Walnut plantations
  - Beech-maple forest
  - East Fork Poplar Creek and Dace Branch buffer zones
- Sensitive Areas Findings
    - General condition of the vegetation within each area, (major changes or perturbations should be recorded)
    - Observations of any wildlife
    - General condition of streams and springs
  - Monitoring - Monitoring is to occur for at least three more years, with the first of those three years to include the 2002 data. The need for furthering monitoring (beyond the three years) will be evaluated using the available data
    - Bird surveys
    - Amphibians (to be conducted during onsite inspections)
    - Benthic macroinvertebrates (spring samples at sampling locations EFK 6.3, EFK 2.3)
    - Fish (Dace Branch each spring)
  - Mitigation – Follow requirements as defined in 40 CFR 1500-1508
  - Cultural Resources - Continued stewardship and maintenance of the McKamey-Carmichael cemetery and sites 40RE195 and 40RE200
  - Review of the Mitigation Action Plan (MAP) if there is a potential for direct or indirect significant impact of any sensitive resources found on the Horizon Center. This is to be coordinated with the responsible DOE Program office, and is to include, but not be limited to:
    - A new occupant constructing at the Horizon Center
    - A change to an existing operation that has the potential to adversely impact any sensitive resources contained within the Natural Area
    - A significant change to the habitat that is adjacent to the Horizon Center
  - Progress Annual Report

The following monitoring requirements were accomplished in 2004 and findings are included in this report.

Sensitive areas within Natural Area were inspected during December-January; April-June; and September-October periods. The objective was to report general condition of vegetation

and wildlife observations in these areas and to report general conditions of streams and springs. Areas inspected included:

- Perimeter boundary of the Natural Area
- Cave
- Sinkholes
- Canebrakes
- Springs
- Wetlands
- Rare species locations
- East and west corridors
- Walnut plantations
- Beech-maple forest
- East Fork Poplar Creek and Dace Branch buffer zones

Bird surveys were conducted during April and June. The survey procedures and observation sites were the same as those used in previous years. Amphibian and reptiles were observed or heard during onsite inspections, aquatic surveys, and bird surveys.

Benthic macroinvertebrates were sampled in April at EFK-6.3 and EFK-2.3 in East Fork Poplar Creek and at MIK-1.43 in Mitchell Branch. The quantitative and qualitative methods were those used in previous years. Fish were sampled in April at two locations in Dace Branch to determine the presence of the Tennessee Dace.

Maintenance of the McKamey-Carmichael cemetery and sites 40RE195 and 40RE200 was monitored.

There were no new occupants or changes of existing operations that have the potential to adversely impact any sensitive resources contained within the Natural Area. Nor were there any significant changes to the habitat that is adjacent to the Horizon Center. Therefore no mitigation was required.

### **3. SITE ACTIVITIES**

#### **3.1 Construction**

No new construction occurred during year 2004.

#### **3.2 Public and Agency Involvement**

Public involvement consisted of liaison with the City of Oak Ridge regarding dedication of the existing roadways and utilities.

#### **3.3 Mitigation Activities**

No mitigation activity was required.

## 4. ECOLOGICAL MONITORING

The specified sites used for ecological monitoring in 2004 were established in the 1997 baseline studies and used each year thereafter using the same monitoring techniques each year. Data are presented in tables and figures herein.

### 4.1 *Fish Census*

Fish communities are indicators of ecological impacts, changes in water quality on habitat, and biological integrity. Annual surveys during site development and early construction phases indicated fish communities in 2000 were as good as, or better than, the baseline status. Thus, the Peer Review Team recommended discontinuation of monitoring fish at all stations except those in Dace Branch where a population of the Tennessee dace had been reported.

The Tennessee dace has been deemed in-need-of management as determined by the State of Tennessee. The population of Tennessee dace at Station DBK-0.3 in Dace Branch experienced increases from two in 1997 to 19 in 1998. However, it progressively declined to four in 1999 and none in 2000. In 1999 a population of Tennessee dace was located further upstream in a pool above development activities. Due to its status and decline in numbers, the Peer Review Team recommended Dace Branch continue to be surveyed for the Tennessee dace. DBK-0.3 and the pool have been sampled each sampling year since 1999.

#### 4.1.1 Fish Census Study Area and Methods

Dace Branch is a small perennial tributary of East Fork Poplar Creek. At normal flow Dace Branch varies from two feet to three feet in width and ranges from one to six inches in depth. Dace Branch has occasional pools that are wider and deeper. The substrate is sandy loam with gravel bars in some locations. Vegetation overhangs Dace Branch in many locations.

Block nets were placed across Dace Branch at DBK-0.3 to limit the movement of fish out of the area to be sampled. Three passes were made through the sample area using electrofishing equipment to stun fish. The fish were then netted and placed in plastic buckets filled with creek water for safekeeping until they were identified, counted, measured, and released. Data are reported in Table 1.

Biologists blocked in 40 square meters of a pool in Dace Branch immediately below State Highway 95 at the boundary of the Horizon Center that had Tennessee dace in previous years. Electrofishing equipment was used to sample the area until three passes resulted in no new fish being captured. Data are reported in Table 2.

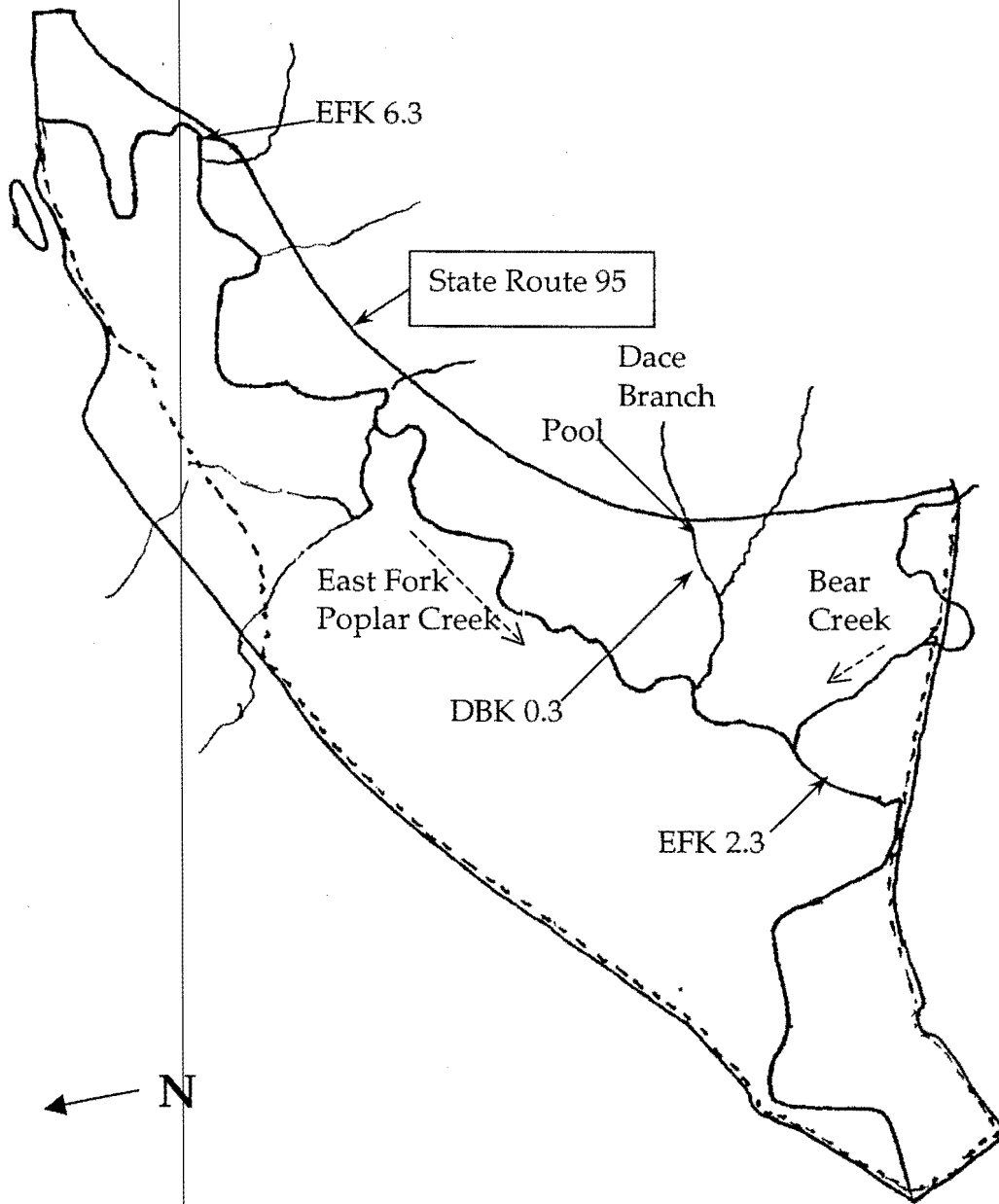
#### 4.1.2 Results and Discussion of Fish Census of Dace Branch

Tables 1 and 2 list the species and numbers of fish collected at DBK-0.3 and the pool at State Route 95 respectively on April 30, 2004. The Tennessee dace was collected from the pool where it had been found since the fall of 2000 (DOE 2000).

Except for the presence of western mosquito fish (*Gambusia affinis*), the fish species present at DBK-0.3 were the same as in 2002 (DOE 2003) and 2003 (DOE 2004). While no species dominated the fish community in 2002, there were increases in central stonerollers (*Campostoma anomalum*) from 26 to 52, creek chub (*Semotilus atromaculatus*) from eight to 16, and blacknose dace (*Rhinichthys atratulus*) from 42 to 76. The increases in creek chub and blacknose dace were due to a general increase in all size classes. However, the increase in central stonerollers was partially due to the presence of young (25-49 mm size class) that were not present in 2003. There were also young creek chub and banded sculpin (*Cottus carolinae*) at this station in 2004. The six saffron shiner (*Notropis rubricroceus*) were less than the 22 in the 2003 sample. The populations of banded sculpin and bluegill (*Lepomis macrochirus*) were similar to those in 2003.

As in 2003, there was no dominant fish species at the pool near State Route 95 (Table 2), whereas, in 2002 (DOE 2003) central stonerollers and creek chub dominated the fish community at the site. The creek chub population increased from 10 in 2003 to 22 in 2004. However, the populations of other species were similar to the 2003 levels.

While there were minor differences in size class distributions within the populations between the two years, the most prominent changes were in the presence of young central stonerollers, creek chub, and banded sculpin in 2004. Western mosquito fish were found at both sites in 2004. This species has not been reported in Dace Branch in previous years.



**Figure 1. Macroinvertebrate and Fish Collection Stations on Horizon Center**

**Table 1. Number of fish collected on April 30, 2004, at Dace Branch (DBK 0.3) in millimeter (mm) size classes. Sampling area is 150 square meters.**

| Species   | Size Class (mm) | Number    |
|---|-----------------|-----------|
| Central stoneroller<br>( <i>Campostoma anomalum</i> ) | 25-49           | 8         |
|   | 50-74           | 21        |
|   | 75-99           | 14        |
|   | <u>100-124</u>  | <u>9</u>  |
|   | Total           | 52        |
| Creek chub<br>( <i>Semotilus atamaculatus</i> )       | 50-74           | 3         |
|   | 75-99           | 6         |
|   | 100-124         | 5         |
|   | <u>125-149</u>  | <u>2</u>  |
|   | Total           | 16        |
| Blacknose dace<br>( <i>Rhinichthys atratulus</i> )    | 50-74           | 38        |
|   | 75-99           | 26        |
|   | <u>100-124</u>  | <u>12</u> |
|   | Total           | 76        |
| Banded sculpin<br>( <i>Cottus carolinae</i> )         | 25-49           | 4         |
|   | 50-74           | 28        |
|   | <u>75-99</u>    | <u>8</u>  |
|   | Total           | 40        |
| Saffron shiner<br>( <i>Notropis rubricroceus</i> )    | 1-24            | 2         |
|   | 25-49           | 3         |
|   | <u>50-74</u>    | <u>1</u>  |
|   | Total           | 6         |
| Western mosquito fish<br>( <i>Gambusia affinis</i> )  | Adults          | 5         |
| Bluegill<br>( <i>Lepomis macrochirus</i> )            | 75-99           | 2         |

**Table 2. Number of fish collected on April 30, 2004, in pool of Dace Branch at State Route 95 reported in millimeter (mm) size classes and density is in numbers per square meter.**

| Species   | Size Class (mm) | Number   | Density |
|---|-----------------|----------|---------|
| Central stoneroller<br>( <i>Campostoma anomalum</i> ) | 25-49           | 2        | 0.55    |
|   | 50-74           | 8        |         |
|   | 75-99           | 10       |         |
|   | <u>100-124</u>  | <u>2</u> |         |
|   | Total           | 22       |         |
| Creek chub<br>( <i>Semotilus atamaculatus</i> )       | 50-74           | 4        | 0.35    |
|   | 75-99           | 5        |         |
|   | 100-124         | <u>5</u> |         |
|   | Total           | 14       |         |
| Tennessee dace<br>( <i>Phoxinus tennesseensis</i> )   | 75-99           | 2        | 0.05    |
| Blacknose dace<br>( <i>Rhinichthys atratulus</i> )    | 50-74           | 11       | 0.38    |
|   | <u>75-99</u>    | <u>4</u> |         |
|   | Total           | 15       |         |
| Banded sculpin<br>( <i>Cottus carolinae</i> )         | 25-49           | 3        | 0.53    |
|   | 50-74           | 12       |         |
|   | <u>75-99</u>    | <u>6</u> |         |
|   | Total           | 21       |         |
| Western mosquito fish<br>( <i>Gambusia affinis</i> )  | Adult           | 2        | 0.05    |

## 4.2 Amphibian and Reptile Observations

The Revised MAP requires reporting of incidental observations of amphibians and reptiles during ecological monitoring activities. These monitoring activities included seasonal observation tours by biologists, avian surveys, fish collections, and macroinvertebrate collections.

Various species of frogs were seen or heard throughout the floodplains of East Fork Poplar Creek, Bear Creek, and Dace Branch, at wetlands associated with sinkholes, and at springs. Occasional calls were also heard in upland areas. Figure 2 shows the general location of the areas referenced in the descriptions that follow.

Breeding calls of the American toads (*Bufo americanus*) were heard from early March through the middle of June wherever there are wet areas on the Horizon Center. Egg masses were seen in shallow waters in wetlands and pools along roadways. Adults were seen in developed areas along Imperium Drive, Novus Drive, and the eastern segment of the perimeter road during spring, summer, and fall monitoring inspections.

Spring peepers (*Hyla crucifer*) were heard from March into May. These small frogs were restricted to wet areas in the floodplains where rooted vegetation emerged from shallow standing water. In the earlier and later portions of their breeding season their calls were heard only at night. During the height of their breeding season they could be heard during the day as well.

Cope's gray treefrogs (*Hyla versicolor*) were heard in many locations on the Horizon Center from April through June. Their calls were heard more frequently in the permanently flooded wetlands along the northern portion of the perimeter road from the East Fork Poplar Creek bridge to Upper Area 1. They were heard less frequently in the East Fork Poplar Creek and Dace Branch floodplains.

Upland chorus frogs (*Pseudacris triseriata*) were heard in several locations along the East Fork Poplar Creek floodplain in April and early May. They were heard less frequently in uplands along the perimeter road north of the upper reaches of East Fork Poplar Creek and Upper Area 1. During the last week in April, they were heard in developed areas along Renovare Boulevard adjacent to Dace Branch floodplain. This frog is well adapted to developed areas.

Green frogs (*Rana clamitans*) were heard from April through June in the East Fork Poplar Creek floodplain between its confluence with Dace Branch and the perimeter road bridge. They were occasionally heard in the wetlands associated with Upper Area 1.

Bullfrogs (*Rana catesbeiana*) were seen and heard in wetlands in the floodplain of the lower reaches of East Fork Poplar Creek. Several egg masses were seen in the shallow waters of the associated wetlands.

Leopard frogs (*Rana utricularia*) were seen around all areas of the Horizon Center where there was water. In addition, they were often seen on roads and trails after storms.

Numerous painted and slider turtles (*Chrysemys* spp.) were sighted in still or slow moving waters along the lower reaches of East Fork Poplar Creek. The highest concentrations were observed in the shallow permanently flooded wetlands associated with the lower reaches of East Fork Poplar Creek where they basked on numerous emerged logs that received sunlight during much of the day. They were rarely seen along upstream reaches of East Fork Poplar Creek and never on Bear Creek or Dace Branch.

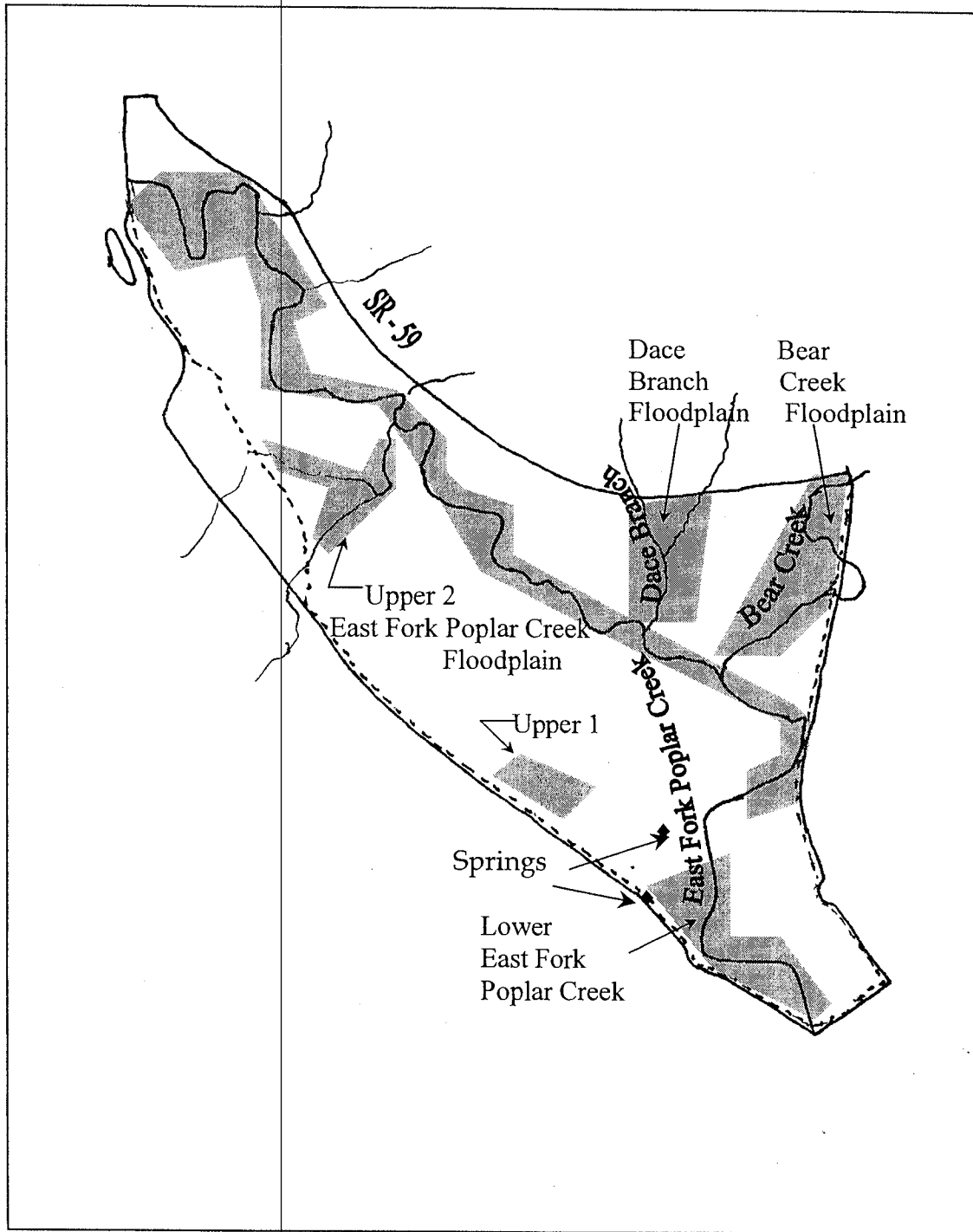
Eastern box turtles (*Terrapene carolina*) were seen along roads and trails throughout the Horizon Center during all seasons of the year. One male was found in the northern cedar glade in the fall.

A black racer (*Coluber constrictor*) was observed on the beech-maple forest floor in June. A clutch of black racer eggs was found along the perimeter road near Partners for Flight Avian Survey site 89 (Figure 3).

Several rat snakes (*Elaphe obsoleta spiloides*) were observed along an abandoned road to the east of Imperium Drive during the spring and early summer. Two were observed to be in molt during the last week of April.

Several northern water snakes (*Natrix sipedon*) were observed on logs within the permanently flooded wetlands in upper area 1. A northern copperhead (*Agkistrodon contortrix*) was observed adjacent to the McKamey-Carmichael cemetery in April.

There were no new occupants or changes of existing operations that have the potential to adversely impact any sensitive resources contained within the Natural Area. Nor were there any significant changes to the habitat to the Horizon Center. Therefore no mitigation was required.



**Figure 2. Areas Where Amphibians and Reptiles were Observed in 2004.**

### 4.3 Avian Census

In order to establish baseline data for bird life throughout Horizon Center, a series of bird censuses were conducted prior to the onset of construction activities. Subsequent surveys have followed the same routes and stations.

The observation stations consist of permanent 50-meter fixed-radius plots established at 300-meter intervals along the Periphery Route and the Floodplain Route (Figure 3). Each observation station has been permanently marked with an individual identification number on a 10-cm x 10-cm orange placard. The Periphery Route originally had 19 observation stations. However, Observation Station 92 no longer exists due to extensive clearing of that part of the Horizon Center. The floodplain route has 25 observation stations.

The Periphery Route passes through several habitat types including areas of timber harvest, upland forest, and wetlands. It also borders large portions of the Natural Area and upland forests beyond the property boundaries. Large areas of the Periphery Route, from Observation Station 88 through Observation Station 98, was cut for timber or have succumbed to pine beetle infestation in the last 15 years. These areas are characterized by piled brush, log debris, snags, sparsely scattered hardwoods and standing dead pines overgrown by dense ground vegetation such as honeysuckle (*Lonicera* spp.), sourwood (*Oxydendrum arboreum*), sumac (*Rhus* spp.), and brambles (*Rubus* spp.). These areas are in various stages of succession leading to hardwood forests. The remainder is in upland forests that are well-drained with mixed deciduous trees forming a canopy. Most areas have well developed understory and ground cover. Canopy trees include oaks (*Quercus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), tulip poplar (*Liriodendron tulipifera*) and American beech (*Fagus grandifolia*) in varying combinations depending on slope and aspect. The understory and shrub layers contain saplings and pole-sized trees including dogwood (*Cornus* spp.), oak, hickory, maple, and beech. The ground cover consists of seedlings of canopy or understory species, ferns, and various herbaceous plants.

The Floodplain Route passes through a mixed deciduous forest in the valley bottom on East Fork Poplar Creek and Bear Creek. The bottomland forest has at least three strata with varied flora, including canopy, understory or shrub layer, and ground cover. Canopy species include sweetgum (*Liquidambar styraciflua*), American sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), elms (*Ulmus* spp.), ash (*Fraxinus* spp.), black willow (*Salix nigra*) and, infrequently oak and pine (*Pinus* spp.). The understory and shrub layer contains saplings and pole-sized trees of the canopy species, ironwood (*Carpinus caroliniana*), hop hornbeam (*Ostrya virginiana*), and red maple (*Acer rubrum*). The ground cover is dense in most areas and contains grasses, vines, and canes. Steep and low exposed banks of bare soil and small rock cliffs and ledges are common.

#### 4.3.1 Avian Census Methods

In April 2004, four surveys were conducted along the Periphery Route, two surveys were conducted along the Floodplain Route, and one listening survey was conducted along the streets of the Horizon Center in April for nightjars, owls and turkeys. In June 2004, two surveys were conducted along the Periphery Route and two surveys were conducted along the Floodplain

Route. All birds seen or heard inside or outside the 50-m radius were noted as an addendum. Birds flushed by researchers entering or leaving the 50-m radius and fly-over birds were also noted. Five minute's observations at each observation station were divided into two periods, the first three minutes and the last two minutes. Sex and maturity were designated when known. Time, temperature, and weather conditions were noted at the beginning of each route and at each observation station.

Birds sighted or heard while investigators conducted other investigations were recorded as incidental. In addition, listening posts were established along roads throughout the Horizon Center for amphibians and birds calling at pre-dawn and dusk during these general observation tours.

#### 4.3.2 Results and Discussion of Avian Census

Table 3 summarizes birds observed on the Floodplain and Peripheral Routes at the Horizon Center during April and June of 2004. Many of the birds observed in April are considered to be migrants, whereas, those observed in June are considered to be breeding residents.

The diversity and distribution in bird fauna for 2004 was similar to previous years. Ninety-one species of birds were observed on the Horizon Center during 2004. Black-throated Blue Warbler, Grasshopper Sparrow, and Rock Pigeon had not been reported in the previous years. Some species that had been reported as common in previous years were not observed in the surveys of 2004.

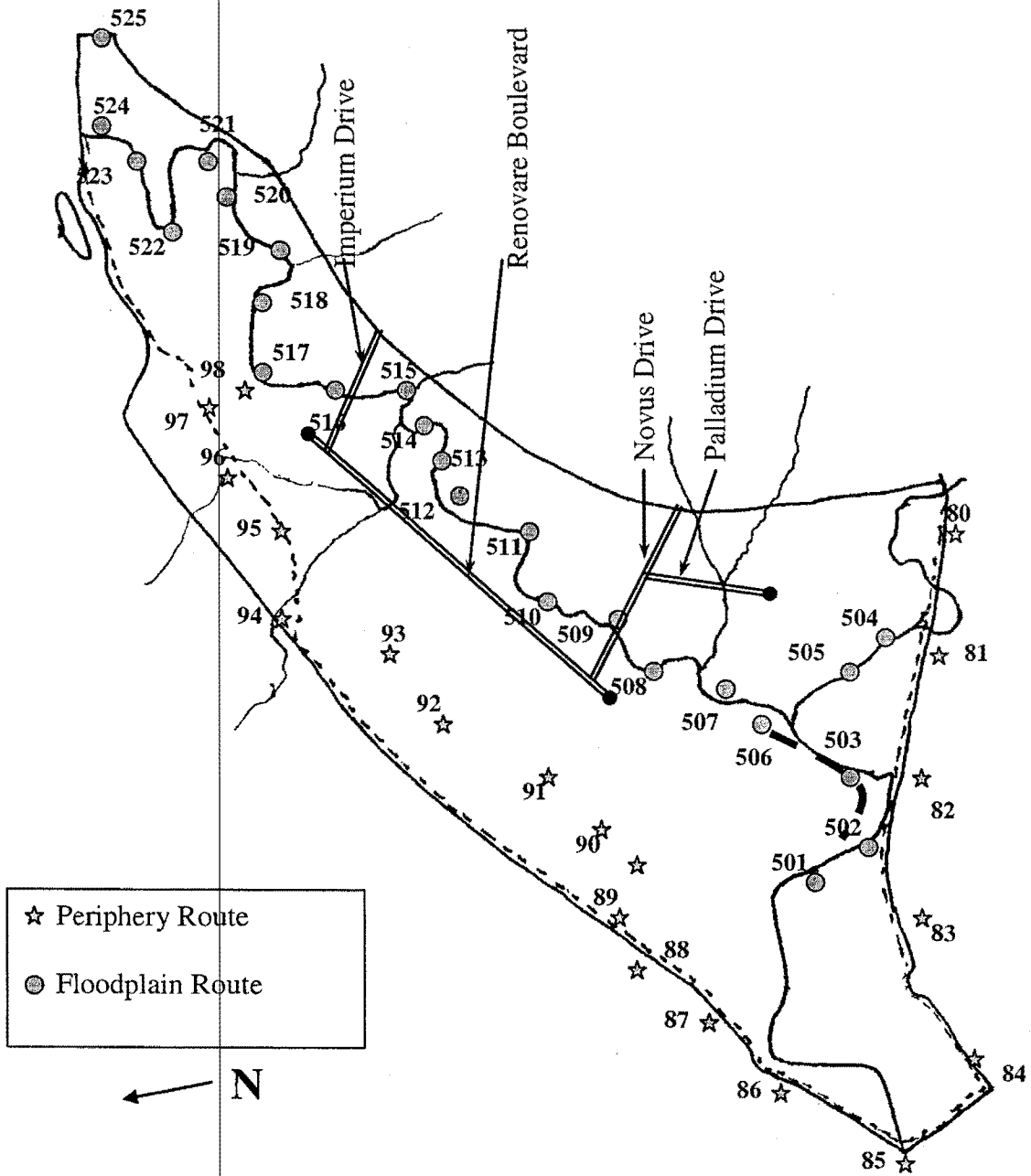


Figure 3. Bird Survey Locations along Periphery Route and Floodplain Route.

**Table 3. Birds Observed on the Horizon Center along Peripheral Route, Floodplain Route, and Night.**

| Common Name               | Binomial Name                   | Periphery |      | Floodplain |      | Night |
|---------------------------|---------------------------------|-----------|------|------------|------|-------|
|                           |                                 | April     | June | April      | June | April |
| Great Blue Heron          | <i>Ardea herodias</i>           | X         | X    | X          | X    |       |
| Green Heron               | <i>Butorides virescens</i>      |           |      |            | X    |       |
| Wood Duck                 | <i>Aix sponsa</i>               | X         | X    |            |      |       |
| Canada Goose              | <i>Branta canadensis</i>        | X         | X    | X          |      |       |
| Broad-winged Hawk         | <i>Buteo platypterus</i>        | X         |      | X          | X    |       |
| Red-shouldered Hawk       | <i>Buteo lineatus</i>           | X         |      | X          |      |       |
| Red-tailed Hawk           | <i>Buteo jamaicensis</i>        |           |      |            | X    |       |
| Black Vulture             | <i>Coragyps atratus</i>         | X         |      | X          |      |       |
| Turkey Vulture            | <i>Cathartes aura</i>           | X         |      |            | X    |       |
| Northern Bobwhite         | <i>Colinus virginianus</i>      | X         | X    |            | X    |       |
| Wild Turkey               | <i>Meleagris gallapavo</i>      | X         | X    | X          | X    |       |
| Killdeer                  | <i>Charadrius vociferus</i>     |           |      | X          | X    |       |
| American Woodcock         | <i>Scolopax minor</i>           |           |      | X          | X    |       |
| Mourning Dove             | <i>Zenaida macroura</i>         | X         | X    | X          | X    | X     |
| Rock Pigeon               | <i>Columba livia</i>            |           | X    |            |      | X     |
| Yellow-billed Cuckoo      | <i>Coccyzus americanus</i>      |           |      | X          | X    |       |
| Chuck-will's-widow        | <i>Caprimulgus carolinensis</i> | X         |      |            |      | X     |
| Whip-poor-will            | <i>Caprimulgus vociferus</i>    |           |      |            |      | X     |
| Ruby-throated Hummingbird | <i>Archilochus colubris</i>     | X         | X    | X          | X    |       |
| Chimney Swift             | <i>Chaetura pelagica</i>        | X         | X    | X          | X    |       |
| Belted Kingfisher         | <i>Ceryle alcyon</i>            | X         | X    | X          | X    |       |
| Northern Flicker          | <i>Colaptes auratus</i>         | X         | X    | X          | X    |       |
| Downy Woodpecker          | <i>Picoides pubescens</i>       | X         | X    | X          | X    |       |
| Hairy Woodpecker          | <i>Picoides villosus</i>        | X         | X    | X          |      |       |
| Pileated Woodpecker       | <i>Dryocopus pileatus</i>       | X         | X    | X          | X    |       |
| Red-bellied Woodpecker    | <i>Melanerpes carolinus</i>     | X         | X    | X          | X    |       |
| Acadian Flycatcher        | <i>Empidonax virescens</i>      | X         | X    | X          | X    |       |
| Great Crested Flycatcher  | <i>Myiarchus crinitus</i>       | X         | X    |            |      |       |
| Eastern Phoebe            | <i>Sayornis phoebe</i>          | X         | X    | X          | X    |       |
| Eastern Wood-Pee-wee      | <i>Contopus virens</i>          | X         | X    |            | X    |       |
| Barn Swallow              | <i>Hirundo rustica</i>          |           |      |            | X    |       |
| American Crow             | <i>Corvus brachyrhynchos</i>    | X         | X    | X          | X    |       |
| Blue Jay                  | <i>Cyanocitta cristata</i>      | X         | X    | X          | X    |       |
| Carolina Chickadee        | <i>Parus carolinensis</i>       | X         | X    | X          | X    |       |
| Tufted Titmouse           | <i>Parus bicolor</i>            | X         | X    | X          | X    |       |
| White-breasted Nuthatch   | <i>Sitta carolinensis</i>       | X         | X    | X          | X    |       |
| Carolina Wren             | <i>Thryothorus ludovicianus</i> | X         | X    | X          | X    |       |
| Blue-gray Gnatcatcher     | <i>Polioptila caerulea</i>      | X         | X    | X          | X    |       |
| Ruby-crowned Kinglet      | <i>Regulus calendula</i>        | X         |      |            |      |       |
| Eastern Bluebird          | <i>Sialia sialis</i>            |           |      | X          |      |       |
| American Robin            | <i>Turdus migratorius</i>       | X         | X    |            |      |       |
| Wood Thrush               | <i>Hylocichla mustelina</i>     | X         | X    | X          | X    |       |
| Gray Catbird              | <i>Dumetella carolinensis</i>   |           |      |            | X    |       |

Table 3 Continued

| Common Name                  | Binomial Name                  | Periphery |      | Floodplain |      | Night |
|------------------------------|--------------------------------|-----------|------|------------|------|-------|
|                              |                                | April     | June | April      | June | April |
| Brown Thrasher               | <i>Taxostoma rufum</i>         | X         |      | X          |      |       |
| Red-eyed Vireo               | <i>Vireo olivaceus</i>         | X         | X    | X          | X    |       |
| White-eyed Vireo             | <i>Vireo griseus</i>           | X         | X    | X          | X    |       |
| Yellow-throated Vireo        | <i>Vireo flavifrons</i>        | X         | X    | X          | X    |       |
| Yellow-breasted Chat         | <i>Icteria virens</i>          | X         | X    | X          | X    | X     |
| Ovenbird                     | <i>Seiurus aurocapillus</i>    | X         | X    |            | X    |       |
| Northern Parula              | <i>Parula americana</i>        | X         | X    | X          | X    |       |
| American Redstart            | <i>Setophaga ruticilla</i>     |           |      |            | X    |       |
| Black-and-white Warbler      | <i>Mniotilta varia</i>         |           |      | X          | X    |       |
| Black-throated Blue Warbler  | <i>Dendroica caerulescens</i>  | X         |      |            |      |       |
| Black-throated Green Warbler | <i>Dendroica virens</i>        | X         |      |            |      |       |
| Blackpoll Warbler            | <i>Dendroica striata</i>       |           |      | X          |      |       |
| Blue-winged Warbler          | <i>Vermivora pinus</i>         | X         | X    | X          | X    |       |
| Cerulean Warbler             | <i>Dendroica cerulea</i>       | X         |      |            |      |       |
| Chesnut-sided Warbler        | <i>Dendroica pensylvanica</i>  |           |      | X          |      |       |
| Hooded Warbler               | <i>Wilsonia citrina</i>        | X         | X    | X          | X    |       |
| Kentucky Warbler             | <i>Oporornis formosus</i>      | X         | X    | X          | X    |       |
| Nashville Warbler            | <i>Vermivora ruficapilla</i>   | X         |      |            |      |       |
| Palm Warbler                 | <i>Dendroica palmarum</i>      |           |      | X          |      |       |
| Pine Warbler                 | <i>Dendroica pinus</i>         | X         | X    | X          | X    |       |
| Prairie Warbler              | <i>Dendroica discolor</i>      | X         | X    | X          |      |       |
| Prothonotary Warbler         | <i>Protonotaria citrea</i>     | X         | X    | X          | X    |       |
| Swainson's Warbler           | <i>Limnothlypis swainsonii</i> |           |      | X          | X    |       |
| Worm-eating Warbler          | <i>Helmitherous vermivorus</i> | X         |      |            |      |       |
| Yellow-throated Warbler      | <i>Dendroica dominica</i>      | X         | X    | X          | X    |       |
| Yellow-rumped Warbler        | <i>Dendroica coronata</i>      | X         |      | X          |      |       |
| Louisiana Waterthrush        | <i>Seiurus motacilla</i>       | X         |      | X          |      |       |
| Common Yellowthroat          | <i>Geothlypis trichas</i>      | X         | X    | X          | X    |       |
| Scarlet Tanager              | <i>Piranga olivacea</i>        | X         | X    | X          | X    |       |
| Summer Tanager               | <i>Piranga rubra</i>           | X         | X    | X          |      |       |
| Indigo Bunting               | <i>Passerina cyanea</i>        | X         | X    | X          | X    |       |
| Northern Cardinal            | <i>Cardinalis cardinalis</i>   | X         | X    | X          | X    | X     |
| Blue Grosbeak                | <i>Guiraca caerulea</i>        |           |      | X          | X    |       |
| Rose-breasted Grosbeak       | <i>Pheucticus ludovicianus</i> | X         |      | X          |      |       |
| Chipping Sparrow             | <i>Spizella passerina</i>      |           |      | X          | X    |       |
| Field Sparrow                | <i>Spizella pusilla</i>        | X         | X    | X          |      |       |
| Grasshopper Sparrow          | <i>Ammodramus savannarum</i>   |           |      |            | X    |       |
| Song Sparrow                 | <i>Melospiza melodia</i>       | X         |      | X          | X    |       |
| Swamp Sparrow                | <i>Melospiza georgiana</i>     | X         |      |            |      |       |
| White-throated Sparrow       | <i>Zonotrichia albicollis</i>  | X         |      | X          |      |       |
| Eastern Towhee               | <i>Pipilo erythrophthalmus</i> | X         | X    | X          | X    |       |
| Red-winged Blackbird         | <i>Agelaius phoeniceus</i>     | X         |      | X          |      |       |
| Brown-headed Cowbird         | <i>Molothrus ater</i>          | X         | X    | X          | X    |       |
| Common Grackle               | <i>Quiscalus quiscula</i>      | X         | X    |            |      |       |

Table 3 Continued

| Common Name        | Binomial Name               | Periphery |      | Floodplain |      | Night |
|--------------------|-----------------------------|-----------|------|------------|------|-------|
|                    |                             | April     | June | April      | June | April |
| Eastern Meadowlark | <i>Sturnella magna</i>      |           |      | X          | X    |       |
| Orchard Oriole     | <i>Icterus spurius</i>      |           | X    |            |      |       |
| Purple Finch       | <i>Carpodacus purpureus</i> | X         |      |            |      |       |
| American Goldfinch | <i>Carduelis tristis</i>    | X         | X    | X          | X    |       |

Clearing land and constructing bridges and buildings has provided new types of habitat for birds on the Horizon Center. Barn Swallows, Chimney Swifts, and House Wren use construction components (e.g. bridges and buildings) for nesting and perches. The Barn Swallows, and House Wren were found nesting under bridges crossing East Fork Poplar Creek in the late spring and summer of 2004. The Chimney Swifts frequently fed over cleared areas from mid-afternoon to near dark. Killdeer, Common Grackle, and European Starling also used cleared areas for feeding. Several Killdeer nests were observed in many locations throughout the spring and summer.

During planning stages of Horizon Center, there had been concern that bridge corridors would fragment the riverine bottomland forest and prevent neotropical song birds from migrating. The number of neotropical migratory species increased on both sides of the bridges in years following construction, suggesting that the roadways crossing the floodplain have not negatively impacted habitat continuity, an important factor in migration.

The concern was expressed during public meetings that there would be an invasion of European Starlings and Brown-headed Cowbirds following completion of the first phase of construction. While there does not appear to be an increase in European Starlings, there is an increase in numbers and distribution of Brown-headed Cowbirds in 2004.

The avian surveys and general observations found several birds that are on federal or state lists for special concerns. Cerulean Warblers and Swainson's Warblers are on the federal list as "Species of Management Concern." The following are on Tennessee's list of "Species of Special Concern."

Yellow-billed Cuckoo  
Whip-poor-will  
Chuck-will's-widow  
Acadian Flycatcher  
Eastern Wood-Pee-wee  
White-eyed Vireo  
Yellow-throated Vireo  
Orchard Oriole  
Black-throated Green  
Hooded Warbler

Kentucky Warbler  
Louisiana Waterthrush  
Northern Parula  
Prairie Warbler  
Prothonotary Warbler  
Yellow-throated Warbler  
Worm-eating Warbler  
Black-throated Blue Warbler  
Blue-winged Warbler  
Wood Thrush

The following discussions are of bird species of special concern on the Horizon Center because they are rare, numerous, of game importance, or on a state or federal list.

Wood Ducks were very active along East Fork Poplar Creek and Bear Creek during the winter, spring, and fall of 2004. Single Wood Ducks were flushed along East Fork Poplar Creek from its entry to its exit of the Horizon Center and the permanently flooded wetland on the northwestern corner of the Horizon Center on each of the winter investigation visits. Pairs of Wood Ducks were flushed or sighted on water in these locations during the spring visits. On April 25, a female Wood Duck was seen leading 12 young Wood Ducks along the creek between Observation Stations 509 and 510 on the Floodplain Route. Another was swimming with her brood among the emergent vegetation in the flooded wetland near Periphery Route Station 86 on April 30.

Mallard Ducks were not reported in the Partners in Flight surveys. However, they were sighted as incidentals during the winter and spring in the lowlands near the end of East Fork Poplar Creek. No young were seen, as was the case in 2000.

Canada Geese were observed in various locations on the Horizon Center throughout the year. A nesting pair occupied a nest site on a peninsula of high ground protruding into a wetland in the lower reaches of the East Fork Poplar Creek floodplain. This is near the site a pair reared young in 2003.

The Broad-winged Hawk's nest at Observation Station 80 on the Periphery Route went unused in 2004. However, one Broad-winged Hawk acted very territorial around Observation Station 507 on the Floodplain Route in late April and May. No young broad-winged hawks were observed in 2004.

At least two coveys of Northern Bobwhite were observed in the spring and summer. One was in the open land to the east of Imperium Drive. The other was along powerline and road right-of-ways through primary succession along perimeter road just west of State Route 95. Northern Bobwhites were also heard near McKamey-Carmichael cemetery in August.

Wild Turkeys are very common throughout the Horizon Center. Several broods were observed in the late spring through the summer.

During the April 30 night bird survey, three Chuck-will's-widows and four Whip-poor-wills were heard along the streets of the Horizon Center. Both are listed as species of special concern by the Tennessee Wildlife Resources Agency.

During the spring and summer a Belted Kingfisher was observed to frequent a four inch diameter hole in a clay bank opposite Observation Station 509 on the Floodplain Route. The Novus Drive bridge is within sight of this nest. No young were observed. Numerous Belted Kingfishers were also observed along other reaches of East Fork Poplar Creek and the permanently flooded wetland on the northwest end of the Horizon Center.

A pair of Pileated Woodpecker established a nest in a cavity in a dead pine at Observation Station 519 on the Floodplain Route. They were observed entering or leaving the nest on several

days during the spring and early summer. On two occasions, one bird remained in the cavity for at least 20 minutes. Another male Pileated Woodpecker exhibited aggressive nesting and territorial behavior at Observation Station 504 in the Bear Creek floodplain. A local search did not discover a nest site. No previous incident of Pileated Woodpecker nesting has been reported on the Horizon Center.

Historically Ruby-crowned Kinglets have been scarce on the Horizon Center. None were noted in 2003 and one was reported in 2002. However, in April 2004 many were seen or heard along the perimeter road. They were most commonly found in eastern red cedar and the various pines along the uplands.

Even though the Wood Thrush is listed as a species of special concern by the TWRA, it has been observed in each of the last three years. It appears the Wood Thrush is increasing in numbers and distribution because in 2004 several were heard along the wooded portions of both routes throughout the late spring and early summer.

The Blue-winged Warbler is another bird listed as a species of special concern by the TWRA that was common during the April surveys on both routes. It was less common in June and was restricted to the northwest quadrant of the Horizon Center.

Black-throated Blue Warbler, a species listed as a species of special concern by the TWRA, was observed for the first time on the Horizon Center on April 30, 2004. This was a single male singing near Observation Station 95 on the Periphery Route.

The Cerulean Warbler is listed as a species of special concern by the TWRA and is "Deemed in Need of Management" by the state. It is also on the federal list as a Species of Management Concern. These rare neotropical migrants normally do not nest within the Ridge and Valley province, therefore those that are observed on the Horizon Center are probably migrating through the region. On April 24, 2004, one Cerulean Warbler was heard along the Periphery Route on the egress from Observation Station 97. Others have been observed and reported in 2003 (DOE 2004), 1999 (DOE 1999), and in the baseline study of 1996 (DOE 1996).

Swainson's Warbler is listed as a species of special concern by the TWRA and is "Deemed in Need of Management" by the state. It is also on the federal list as a Species of Management Concern by the US Fish and Wildlife Service. Swainson's Warbler is a very secretive bird that is difficult to see and becomes very quiet when people are present. Three Swainson's Warbler were heard in April and June of 2004. One bird was heard on April 29 along the Floodplain Route at Observation Station 520. One bird was heard between Observation Stations 519 and 520 on June 5. Another Swainson's Warbler was heard at Observation Station 525 on June 27. A single Swainson's Warbler was heard near Observation Station 515 in April of 2002 and 2003.

A Worm-eating Warbler was heard at Observation Station 88 along the Periphery Route on April 24 and again on April 30. This species is listed as a species of special concern by the TWRA.

One Black-and-white Warbler was heard along the Floodplain Route on June 27 at Observation Station 519. Black-and-white Warblers have been found in diverse areas of the Horizon Center in previous years.

Historically sightings of Prothonotary Warblers were rare on the Horizon Center. In 2004 many were sighted and heard along the East Fork Poplar Creek and permanently flooded wetlands in the floodplain. Adults were observed entering cavities in snags standing in wetlands in the northeast corner of the Horizon Center during the early summer.

An American Redstart was heard along the Floodplain Route on June 5 between Observation Stations 507 and 508. The American Redstart is rare to the Horizon Center and has not been reported here in the last three years.

The Ovenbird is also a secretive bird that usually inhabits thick underbrush. They were heard several times near Observation Stations 94 and 95 during April and early June. In June and July an Ovenbird was heard and seen several times on the East Fork Poplar Creek floodplain near Observation Station 519. Ovenbirds were reported on the Horizon Center in 2002 and 2003, but never during the summer.

A Grasshopper Sparrow was heard along the Floodplain Route on the ingress to Observation Station 509 from the grassy field bordering the creek. This is the first time this species has been observed on the Horizon Center.

One Orchard Oriole was heard along the Floodplain Route at Observation Station 524 on April 5. This species is listed as a species of special concern by the Tennessee Wildlife Resources Agency.

In summary, the diverse habitat types in the floodplain corridor supported a diverse community of breeding birds in 2004. In the spring, the Horizon Center was used as a migration corridor as is typical of unfragmented bottomland forests of the region. The crossing of road right-of-ways and bridges did not appear to adversely impact the migration of birds along the East Fork Poplar Creek corridor. The upland corridors, that connect the bottomland corridor along East Fork Poplar Creek and the uplands of the ridges, support diverse bird communities. The increase in diverse habitat types along the upland corridor following deforestation resulting from pine beetle infestation has likely contributed to increased bird diversity and numbers of individuals. The data show areas within the Horizon Center are being used as breeding territory for some state and federal species listed as being in need of management.

#### **4.4 Benthic Macroinvertebrate Census**

Benthic macroinvertebrates are small animals large enough to be seen with the unaided eye that live on or among the substrate particles in bodies of water. Their life span of several months make them ideal for use in following long-term ecological trends associated with impacts. However, the high variability of macroinvertebrate communities makes causes of short-term fluctuations difficult to identify.

The objectives of the stream benthic macroinvertebrate studies were to: (1) characterize the benthic macroinvertebrate communities of an upstream station (EFK-6.3) and a downstream station (EFK-2.3) within the Horizon Center; (2) compare community structures with those observed during the collection of baseline data in 1996 (DOE 1997) and with an offsite station

(Mitchell Creek MIK-1.43); and (3) document the presence of any federal or state listed threatened, endangered, or in-need-of management species.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT). Taxa richness and concentrations of tolerant versus intolerant groups when used over a number of years are also indicators of well being of a habitat. Ratings can also be assigned with a Tolerance Value (TV) index that summarizes tolerance. No baseline or criteria for these TV indices have been established for streams in this region of Tennessee; thus, the indices are used here only to provide general indications of water quality.

#### 4.4.1 Benthic Macroinvertebrate Census Methods

Figure 1 indicates the location of macroinvertebrate survey sites on the Horizon Center. An offsite station on Mitchell Branch at kilometer 1.43 (MIK-1.43) was originally used as a reference because it was similar to Dace Branch and had a long-term historical database available for comparisons. Even though Mitchell Branch is very different from East Fork Poplar Creek it continues to be used as an indicator of annual fluctuations of benthic communities in the area.

Surber samplers equipped with a 363-micrometer mesh net were used to collect quantitative samples in triplicate at each station. Kick nets were used to collect qualitative samples throughout each site. Samples were placed in jars and preserved with 95 percent ethyl alcohol and taken to the laboratory. To avoid sample decomposition caused by dilution of the original preservative, the ethanol was replaced with a permanent preservative. Organisms were picked from the debris in the samples, identified to the lowest practical taxon, and enumerated.

#### 4.4.2 Results and Discussion of Benthic Macroinvertebrate Census

Table 4 is a composite checklist of the benthic macroinvertebrates collected by qualitative kick net and quantitative surber samples from the three stations in April of 2004. The reported number represents the total number of each type of organism in three samples of 0.1 square meters ( $m^2$ ) of stream bottom. Additional types of organisms observed in the qualitative samples are represented by an "X" in the tables. In addition, most taxa are annotated by Functional Feeding Groups (FFG) and a Tolerance Value (TV).

Mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) are generally intolerant to organic wastes and sediments, and are indicators of good water quality. Chironomids are generally tolerant to organic wastes, natural detritus, and sediments. Thus, taxa richness and percentage of individuals of chironomids and Ephemeroptera + Plecoptera + Trichoptera (EPT) are reported for each site in Table 5. Table 6 shows the number of individuals in the three surber samples within each of the FFG.

EFK-6.3 – This upstream station on East Fork Poplar Creek was composed of alternating shallow pools and riffles at the time it was sampled in 2004. The flow was slow to moderate. Substrate of the pools was predominantly coarse sand. The riffles were predominantly rough

bedrock intermittently covered with small to medium cobble. Qualitative samples were taken throughout the site, while quantitative surber samples were only collected in the riffles.

There were 51 different types of organisms collected in the quantitative and qualitative samples (Table 4). The quantitative samples had 39 different types of organisms with a community density of 95 individuals/0.1 m<sup>2</sup> (Table 5). EPT organisms dominated (51.5 percent) the macroinvertebrate community at EFK-6.3 in the spring of 2004. The concentration of chironomids was very low (6.3 percent) as compared with 2003 when chironomids dominated with 59.9 percent.

Thus, the macroinvertebrate community structure at EFK-6.3 was unusual in 2004. The community density of 114 individuals/0.1 m<sup>2</sup> was considerably lower than the 1264 individuals/0.1 m<sup>2</sup> reported in 2003. The reduction is attributed to a decrease in chironomids from 59.5 percent to 6.3 percent. In 2004 the EPT species dominated with 51.5 percent, whereas, in 2003 they represented only 17.9 percent. The reduction of chironomids was accompanied by an increase of other species of macroinvertebrates to 42.2 percent from the 22.3 percent in 2003.

Most of the macroinvertebrates at this site feed on natural organic detritus that has been broken into small pieces. Macroinvertebrates that collect or gather small particles on or in the streambed comprise 18.5 percent of the macroinvertebrate community. Those that gather small particles from the water near the streambed or filter organic particles from the water column comprise 73.6 percent of the community. Less than one percent of the macroinvertebrates shred large organic components such as leaves and herbaceous materials. This indicates food for shredders was very limited in the riffle areas where samples were taken. However, numerous small organic particles move through the riffles in the water column and along the streambed, thus supporting macroinvertebrates that gather or filter food from water.

The diversity and community structure are indicators of long-term good water quality where East Fork Poplar Creek enters the Horizon Center.

EFK-2.3 –This station is downstream from EFK-6.3 and development activities on the Horizon Center. Conditions at the station consisted of alternating shallow pools and riffles, and the flow was slow to moderate. Substrate of the pools was predominantly sandy with a small amount of gravel. The riffles were predominantly rough bedrock covered with small to medium cobble with a mixture of gravel and sand. Qualitative samples were taken throughout the site, while the quantitative surber samples were only taken in the riffle areas.

Reduction in numbers of chironomids (from 83.7 percent to 36.3 percent) is, in part, responsible for shifts in the macroinvertebrate community structure at EFK-2.3 in 2004 as compared to previous years. There were 59 different types of macroinvertebrates collected at Station EFK-2.3 in 2004. While this is greater than the 43 taxa collected in 2003 it is less than 79 taxa collected in 2002. The concentration of macroinvertebrates is less than in previous years. The number of EPT species that are intolerant to organic wastes and sediments continue to be high and have increased in concentration from 5.6 percent in 2002 and 9.6 percent in 2003 to 49.6 percent in 2004. This is accompanied by a slight increase in concentrations of macroinvertebrates other than EPT and chironomids.

The macroinvertebrate communities at EFK-2.3 during each spring since 1997 have been dominated (70 to 90 percent) by chironomids. The reduction in 2003 (DOE 2004) was interpreted as an increase in numbers of individuals of other species. However, in 2004, there is a reduction in numbers of all species, but with a greater reduction in chironomids.

The reduction in chironomids in 2004 is due to reduced number of chironomids that shred vegetative matter in the stream. Most of the chironomids that are there collect and gather small organic particles or filter organic material from the flowing water. This feeding opportunity is supported by the concentrations of collector/gather organisms (27.7 percent) and filtering/collectors (56.5 percent) in the EFK-2.3 macroinvertebrate community (Table 6). Apparently the opportunity for shredders is low as indicated by the low concentration (0.35 percent) of shredders.

MIK-1.43 – This station on Mitchell Creek was established as an offsite control for macroinvertebrate monitoring in the baseline studies in 1996 (DOE 1997). Mitchell Creek varies from two to three feet in width and ranges from three to 12 inches in depth. The year-round flow is over a sandy loam substrate with occasional gravel and sand bars. The flow rate is slow to moderate. The floodplain is vegetated with forbes and shrubs that often overhang the creek.

In the spring of 2002 the density of 355 individuals/0.1 m<sup>2</sup> of the macroinvertebrate community was lower than in any spring sample recorded. In the spring of 2003, the macroinvertebrate density of 558 individuals/0.1 m<sup>2</sup> had recovered to previous conditions. In 2004 the density was 618 individuals/0.1 m<sup>2</sup>. The 40 taxa recorded from the samples indicate the presence of a diverse community structure.

At MIK-1.43 there was an increase from 18.5 percent to 36.2 percent of the macroinvertebrates with reported FFG that shred leaves and other detritus (Table 6). This was accompanied by an increase from 4.9 percent in 2003 to 10.0 percent in 2004 that are collectors and gathers. This indicates the habitat has an abundance of relatively large organic materials to be used as a food source by these shredder herbivores.

The total number of individuals and taxa were greater than in 2002 or 2003. The individuals in taxa other than EPT and chironomids comprised 20.8 percent compared to 25.2 percent of the community in 2002 and 16.6 percent in 2003. In 2004, chironomids comprised 37.1 percent of the macroinvertebrate community as compared with 49.7 percent in 2003. There were 17 species of EPT that comprised 42.1 percent of the macroinvertebrates.

These data indicate shifts in macroinvertebrate community structures within the Horizon center and the control stream. The trends are toward higher concentrations of EPT and lower concentrations of chironomids. These are indicative of either better water quality or lower concentrations of natural organic debris in the streams for the year 2004.

#### 4.4.3 Protected Aquatic Invertebrates

An extensive search for protected aquatic invertebrates was conducted in 2002 (DOE 2003). In 2004 searches for protected aquatic invertebrates was restricted to visual inspections of: (1) East Fork Poplar Creek at sites where macroinvertebrates were collected, cultural resource sites, and sensitive species sites; (2) Dace Branch at fish sampling sites; (3) portions of Bear Creek; (4) wetlands, and (5) springs. No protected aquatic invertebrates were found in 2004.

Table 4. Composite of Quantitative and Qualitative Macroinvertebrate Benthos at each monitoring location in April 2003 and Functional Feeding Group (FFG) and North Carolina Tolerance Value (TV) designations of each taxon. Only Quantitative samples were taken at MIK-1.43.

| SPECIES                      | T.V. | F.F.G. | EFK-6.3 | EFK-2.3 | MIK-1.43 |
|------------------------------|------|--------|---------|---------|----------|
| <b>PLATYHELMINTHES</b>       |      |        |         |         |          |
| <b>Turbellaria</b>           |      |        |         |         | 27       |
| <b>Tricladida</b>            |      |        |         |         |          |
| Planariidae                  |      |        |         |         |          |
| <i>Dugesia tigrina</i>       | 7.2  |        | 1       |         |          |
| <b>NEMATODA</b>              | 6    |        | 1       |         |          |
| <b>MOLLUSCA</b>              |      |        |         |         |          |
| <b>Bivalvia</b>              |      |        |         |         |          |
| Pisidae                      |      |        |         |         |          |
| <i>Pisidium sp</i>           |      |        |         |         | 8        |
| <b>Veneroida</b>             |      |        |         |         |          |
| Corbiculidae                 |      |        |         |         |          |
| <i>Corbicula fluminea</i>    | 6.1  | FC     | 1       | 5       |          |
| <b>Gastropoda</b>            |      |        |         |         |          |
| <b>Mesogastropoda</b>        |      |        |         |         |          |
| Hydrobiidae                  | 8    | SC     |         |         |          |
| <i>Somatogyrus sp.</i>       | 6.4  | SC     |         | 1       |          |
| Pleuroceridae                |      |        |         |         |          |
| <i>Elimia clavaeformis</i>   | 2.5  | SC     | 20      | 9       |          |
| <b>Basommatophora</b>        |      |        |         |         |          |
| Ancylidae                    |      | SC     |         |         |          |
| <i>Ferrissia rivularis</i>   | 6    | SC     | 1       | 2       |          |
| <b>ANNELIDA</b>              |      |        |         |         |          |
| <b>Oligochaeta</b>           | 10   | CG     |         |         | 57       |
| <b>Tubificida</b>            |      |        |         |         |          |
| Lumbricidae                  |      | CG     | 10      | 12      |          |
| Naididae                     | 8    | CG     |         |         |          |
| <i>Slavina appendiculata</i> | 7.1  | CG     | 34      | 9       |          |
| Tubificidae w.o.h.c.         | 7.1  | CG     | 1       |         |          |
| Tubificidae w.h.c.           | 7.1  | CG     |         | 1       |          |
| <b>Lumbriculida</b>          |      |        |         |         |          |
| Lumbriculidae                | 7    | CG     | 2       |         |          |
| <b>ARTHROPODA</b>            |      |        |         |         |          |
| <b>Crustacea</b>             |      |        |         |         |          |
| <b>Isopoda</b>               |      |        |         |         |          |
| Asellidae                    |      | SH     |         |         |          |
| <i>Caecidotea sp.</i>        | 9.1  | CG     | 5       |         |          |
| <i>Lirceus sp.</i>           | 7.9  | CG     |         | 1       | 36       |

Table 4 continued

|                                 |     |    |    |   |     |  |
|---------------------------------|-----|----|----|---|-----|--|
| <b>Amphipoda</b>                |     |    |    |   |     |  |
| Crangonyctidae                  |     |    |    |   |     |  |
| <i>Crangonyx sp.</i>            | 7.9 | CG | 33 | 5 | 1   |  |
| <b>Decapoda</b>                 |     |    |    |   |     |  |
| Cambaridae                      | 7.5 |    |    |   |     |  |
| <i>Cambarus sp.</i>             | 7.6 | P  | 15 |   |     |  |
| <b>Insecta</b>                  |     |    |    |   |     |  |
| <b>Collembola</b>               |     |    |    | 5 |     |  |
| <b>Ephemeroptera</b>            |     |    |    |   |     |  |
| Baetidae                        | 4   | CG |    | 1 |     |  |
| <i>Acentrella sp.</i>           |     | CG |    |   | 2   |  |
| <i>Baetis c.f. flavistriga</i>  | 7   | CG | 2  | 9 | 1   |  |
| <i>Baetis sp.</i>               |     | CG |    |   | 5   |  |
| <i>Centroptilum sp.</i>         | 6.6 | CG |    | 1 |     |  |
| <i>Dipheter hageni</i>          |     | CG |    |   | 9   |  |
| <i>Plauditus sp.</i>            |     | CG |    |   | 1   |  |
| Caenidae                        |     | CG |    |   |     |  |
| <i>Caenis sp.</i>               | 7.4 | CG |    | 1 |     |  |
| Heptageniidae                   | 4   | SC | 1  | 1 |     |  |
| <i>Stenacron interpunctatum</i> | 6.9 | SC | 9  | 1 |     |  |
| <i>Stenonema sp.</i>            | 4   | SC | 4  | 3 |     |  |
| <i>Stenonema mediopunctatum</i> | 3.8 | SC | 2  | 1 |     |  |
| Tricorythidae                   |     | CG |    |   |     |  |
| <i>Tricorythodes sp.</i>        | 5.1 | CG |    | 2 |     |  |
| Leptophlebiidae                 |     |    |    |   |     |  |
| <i>Habrophlebiodes sp.</i>      |     | CG |    |   | 72  |  |
| <b>Odonata</b>                  |     |    |    |   |     |  |
| Coenagrionidae                  |     | P  |    |   |     |  |
| <i>Argia sp.</i>                | 8.2 | P  |    | 1 |     |  |
| Gomphidae                       |     | P  |    |   |     |  |
| <i>Stylogomphus albistylus</i>  | 4.7 | P  | 1  |   |     |  |
| <b>Plecoptera</b>               |     |    |    |   |     |  |
| Leuctridae                      |     | SH |    |   |     |  |
| <i>Leuctra sp.</i>              | 2.5 | SH | 4  |   | 220 |  |
| Capniidae                       |     |    |    |   |     |  |
| <i>Allocapnia sp.</i>           |     | SH |    |   | 29  |  |
| Nemouridae                      |     |    |    |   |     |  |
| <i>Amphinemura sp.</i>          |     | SH |    |   | 234 |  |
| Perlidae                        |     | SH |    |   | 60  |  |
| <i>Eccoptura xanthenes</i>      |     | SH |    |   | 6   |  |
| <i>Perlesta sp.</i>             |     | SH |    |   | 114 |  |
| <i>Isoperla sp.</i>             |     | SH |    |   | 5   |  |
| Chloroperlidae                  |     |    |    |   |     |  |
| <i>Sweltsa sp.</i>              |     | SH |    |   | 1   |  |

Table 4 continued

|                                |     |    |    |     |     |    |
|--------------------------------|-----|----|----|-----|-----|----|
| <b>Hemiptera</b>               |     |    |    |     |     |    |
| Veliidae                       |     |    | P  |     |     |    |
| <i>Rhagovelia obesa</i>        |     |    | P  | 2   |     |    |
| <b>Megaloptera</b>             |     |    |    |     |     |    |
| Sialidae                       |     |    | P  |     |     |    |
| <i>Sialis sp.</i>              | 7.2 | P  |    |     | 1   |    |
| Corydalidae                    |     |    |    |     |     |    |
| <i>Nigronia fasciatus</i>      |     | P  |    |     |     | 1  |
| <b>Trichoptera</b>             |     |    |    |     |     |    |
| Glossosomatidae                |     |    | SC |     |     |    |
| <i>Glossosoma sp.</i>          | 1.6 | SC |    |     | 1   |    |
| <i>Agapetus sp.</i>            |     | SC |    |     |     | 1  |
| Hydropsychidae                 | 4   | FC |    | 88  | 8   |    |
| <i>Cheumatopsyche sp.</i>      | 6.2 | FC |    | 121 | 208 |    |
| <i>Hydropsyche sp.</i>         | 5   | FC |    | 29  |     |    |
| <i>Hydropsyche betteni gp.</i> | 7.8 | FC |    | 108 | 14  |    |
| <i>Diplectrona modesta</i>     |     | FC |    |     |     | 2  |
| Hydroptilidae                  |     |    | PI |     |     |    |
| <i>Leucotrichia sp.</i>        | 3   | SC |    | 1   |     |    |
| <i>Ochrotichia sp.</i>         |     | SC |    |     |     | 1  |
| Leptoceridae                   |     |    | CG |     |     |    |
| <i>Oecetis sp.</i>             | 4.7 | P  |    |     | 1   |    |
| Polycentropodidae              |     |    | FC |     |     |    |
| <i>Neureclipsis sp.</i>        | 4.2 | FC |    |     | 1   |    |
| <i>Polycentropus sp.</i>       | 3.5 | FC |    |     | 1   |    |
| Uenoidae                       |     |    |    |     |     |    |
| <i>Neophylax sp.</i>           | 2.2 | SC |    |     | 1   | 12 |
| Rhyacophilidae                 |     |    |    |     |     |    |
| <i>Rhyacophila sp.</i>         |     |    |    |     |     | 3  |
| Philopotamidae                 |     |    |    |     |     |    |
| <i>Chimarra sp.</i>            |     |    |    |     |     | 3  |
| <b>Coleoptera</b>              |     |    |    |     |     |    |
| <i>Helichus fastigiatus</i>    |     |    |    |     |     | 1  |
| Chrysomelidae                  |     |    |    |     | 1   |    |
| Elmidae                        |     |    | CG |     |     |    |
| <i>Ancyronyx variegata</i>     | 6.5 | SC |    | 1   |     |    |
| <i>Dubiraphia sp.</i>          | 5.9 | SC |    |     | 3   |    |
| <i>Macronychus glabratus</i>   | 4.6 | SH |    | 6   |     |    |
| <i>Microcylloepus pusillus</i> | 2.1 | SC |    | 3   |     |    |
| <i>Optioservus sp.</i>         | 2.4 | SC |    | 5   | 8   | 8  |
| <i>Stenelmis sp.</i>           | 5.1 | SC |    | 10  | 2   | 93 |
| Psephenidae                    |     |    | SC |     |     |    |
| <i>Psephenus herricki</i>      | 2.4 | SC |    |     | 3   |    |

Table 4 continued

|                                       |      |    |   |     |    |     |
|---------------------------------------|------|----|---|-----|----|-----|
| <b>Diptera</b>                        |      |    |   |     |    |     |
| Ceratopogonidae                       |      |    | P |     |    | 25  |
| <i>Bezzia/Palpomyia</i> gp.           | 6.9  | P  |   | 1   |    |     |
| Orthoclaadiinae                       |      |    |   |     |    | 109 |
| Chironomidae                          |      |    |   | 6   | 18 | 70  |
| <i>Ablabesmyia mallochi</i>           | 7.2  | P  |   | 1   | 28 |     |
| <i>Brillia flavifrons</i>             | 5.2  | SH |   |     | 1  |     |
| <i>Cardiocladius</i> sp.              | 5.9  | P  |   | 5   |    |     |
| <i>Conchapelopia</i> sp.              | 8.4  | P  |   | 1   | 10 |     |
| <i>Cricotopus</i> sp.                 | 7    | CG |   | 4   | 15 |     |
| <i>Cryptochironomus</i> sp.           | 6.4  | P  |   |     | 2  |     |
| <i>Endochironomus</i> sp.             | 6    | SH |   |     | 1  |     |
| <i>Microtendipes pedellus</i> gp.     | 5.5  | CG |   |     | 18 |     |
| <i>Paraboreochlus</i> sp.             |      |    |   |     |    | 1   |
| <i>Parametrioctenemus</i> sp.         | 4    | CG |   | 8   | 39 |     |
| <i>Paratendipes</i> sp.               | 5.1  | CG |   |     | 4  |     |
| <i>Polypedilum fallax</i>             | 6.4  | SH |   |     | 1  |     |
| <i>Polypedilum flavum</i> (convictum) | 4.9  | SH |   | 1   | 1  |     |
| <i>Rheocricotopus</i> sp.             | 7.3  | CG |   | 1   |    |     |
| <i>Rheocricotopus robacki</i>         | 7.3  | CG |   | 1   | 12 |     |
| <i>Rheotanytarsus</i> sp.             | 5.9  | FC |   | 3   | 12 |     |
| <i>Stictochironomus devinctus</i>     |      | CG |   |     | 18 |     |
| <i>Synorthocladus semivirens</i>      | 4.36 | CG |   | 4   | 6  |     |
| <i>Tanytarsus</i> sp.                 | 6.8  | FC |   | 1   | 42 |     |
| <i>Tribelos</i> sp.                   | 6.3  | CG |   |     | 4  |     |
| <i>Tvetenia bavarica</i> gp.          | 3.7  | CG |   |     | 58 |     |
| <i>Tvetenia discoloripes</i> gp.      | 3.6  | CG |   | 14  |    |     |
| <i>Xylotopus par</i>                  | 6    | SH |   |     | 5  |     |
| <i>Zavrelia</i> sp.                   | 5.3  | CG |   | 1   | 2  |     |
| Tanypodinae                           |      |    |   |     |    | 89  |
| Tanytarsini                           |      |    |   |     |    | 511 |
| Chironomini                           |      |    |   |     |    | 17  |
| Empididae                             | 7.6  | P  |   |     |    |     |
| <i>Hemerodromia</i> sp.               | 6    | P  |   | 3   | 1  | 3   |
| Simuliidae                            |      | FC |   | 2   |    |     |
| <i>Simulium</i> sp.                   | 6    | FC |   | 107 | 3  | 11  |
| Tabanidae                             |      | PI |   |     |    |     |
| <i>Chrysops</i> sp.                   | 6.7  | PI |   | 1   |    |     |
| <i>Tabanus</i> sp.                    |      | PI |   |     |    | 1   |
| Tipulidae                             |      | SH |   |     |    |     |
| <i>Antocha</i> sp.                    | 4.3  | CG |   | 23  | 10 |     |
| <i>Tipula</i> sp.                     | 7.3  | SH |   | 2   |    | 2   |
| <i>Hexatoma</i> sp.                   |      |    |   |     |    | 3   |
| <i>Pseudolimnophila</i> sp.           |      |    |   |     |    | 1   |

| Table 4 continued                   |  |  |     |     |      |
|-------------------------------------|--|--|-----|-----|------|
| <b>ARACHNID</b>                     |  |  |     |     |      |
| Arachnida                           |  |  |     |     | 1    |
| <b>CHORDATA</b>                     |  |  |     |     |      |
| Osteichthyes                        |  |  |     | 17  |      |
| <b>Total Number of Organisms</b>    |  |  | 711 | 652 | 1857 |
| <b>Total Number of Taxa</b>         |  |  | 51  | 59  | 42   |
| <b>EPT Index (No. of organisms)</b> |  |  | 369 | 255 | 781  |
| <b>Number of EPT taxa</b>           |  |  | 11  | 17  | 17   |

**Table 5. Summary of Benthic Macroinvertebrates from Three Surber Samples for Streams on Horizon Center, April 2003.**

| Site    | Total Number of Taxa (Richness) | Total Number of Individual Organisms | Total Number of EPT Taxa (Richness) | % EPT | % Chironomidae | % Other Taxa | Density /0.1 m <sup>2</sup> |
|---------|---------------------------------|--------------------------------------|-------------------------------------|-------|----------------|--------------|-----------------------------|
| EFK 2.3 | 39                              | 280                                  | 10                                  | 49.6  | 36.3           | 14.1         | 95                          |
| EFK 6.3 | 32                              | 431                                  | 8                                   | 51.5  | 6.3            | 42.2         | 144                         |
| MIK1.43 | 42                              | 1857                                 | 17                                  | 42.1  | 37.1           | 20.8         | 618                         |

Totals represent numbers in all three samples. Richness is the average number of taxa in the three samples taken at that site. Percents are based on number of individuals in the group compared to the total number of individuals. Density is in individuals/0.1 m<sup>2</sup>.

**Table 6. Number and Percent of Macroinvertebrate Individuals in each of the Functional Feeding Groups in Three Surber Samples at Sites EFK-2.3, EFK-6.3, and MIK-1.43.**

| Functional Feeding Groups               | EFK-2.3     | EFK-6.3     | MIK-1.43   |
|---|-------------|-------------|------------|
| Collector/Gathers (Percent of total)    | 79 (27.7%)  | 80 (18.5%)  | 184 (10.0) |
| Filtering/Collectors (Percent of total) | 161 (56.5%) | 318 (73.6%) | 14 (0.75)  |
| Scrapers (Percent of total)             | 16 (5.6%)   | 18 (4.2%)   | 114 (6.1)  |
| Shredders (Percent of total)            | 1 (0.35%)   | 3 (0.7%)    | 671 (36.2) |
| Predators (Percent of total)            | 1 (0.35%)   | 8 (1.9%)    | 29 (1.6)   |
| Piercers (Percent of total)             | 0           | 0           | 1 (0.05)   |
| Unknown (Percent of total)              | 0           | 5 (1.2%)    | 844 (45.4) |

The numbers are based on composites of three Surber samples at each site.

## 4.5 General Vegetation Surveys

The EA and MAP required detailed evaluation of plant communities on a five-year schedule. In 2002 that evaluation was conducted and reported in the annual report (DOE 2003). The Revised MAP requires spring, fall, and winter observations of plant communities throughout the Horizon Center. These were conducted during the 2004 monitoring.

Most of the pine forests have succumbed to the pine beetle infestation and have been replaced by early succession. Young tree species include: tulip poplar (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), and an assortment of maples (*Acer* spp.). In 2004, the vegetation communities in most of these areas are dominated by Japanese honeysuckle (*Lonicera japonica*) and blackberry (*Rubus* sp.).

Almost all plant communities at the Horizon Center had some exotic plants in 2004. Most of the forest floor on the floodplain is dominated by aggressive exotic invaders. These included microstegium (*Eulalia viminea*), privet (*Ligustrum sineses* and *L. vulgare*), and Oriental bittersweet (*Celastrus orbiculatus*). The succession stages of upland forests are dominated by honeysuckle, autumn olive (*Elaeagnus umbellata*), and multiflora rose (*Rosa multiflora*).

## 4.6 Sensitive Community Surveys

DOE found five types of sensitive plant communities on the property prior to leasing it to CROET (DOE, 1997). These were inspected during each of the three seasons in 2004.

### 4.6.1 Beech-Maple Forest

The area designated as the beech-maple forest at the Horizon Center is unusual for the ridge and valley province and is not known to occur elsewhere on the Oak Ridge Reservation (DOE, 1996A). Aerial photographs taken in 1943 show the beech-maple forest area to be intact, although it was completely surrounded by agriculture at the time. The area has not been disturbed since. Due to its longevity and to the vegetation composition, it is considered to be approaching the status of a climax forest. In the Midwest, forests of this type have been ranked critically imperiled because of extreme rarity (Grossman et al. 1994).

There are no observable changes in this area since the study conducted for the 2002 annual report (DOE 2003).

### 4.6.2 Limestone Cliffs

The limestone cliffs identified in the Environmental Assessment (DOE 1996A) are along the left-bank-descending of East Fork Poplar Creek. The cliffs are not high and are intermittent. They are dry. The soils on these limestone cliffs are deeper than those found on most limestone cliffs in the region. Aerial photographs taken in 1943 show the surrounding areas to be cultivated at that time. After the government acquired the land, natural succession vegetated farmland surrounding the upper banks of the limestone cliffs. In latter years the government planted hardwood and pine plantations in the previously farmed lands adjacent to these limestone cliffs. Thus, the makeup of mature vegetation on these limestone cliffs in extensive studies

conducted in 2002 was found to be similar to the surrounding forests. No observable changes occurred during 2004.

A similar region of limestone outcrops is on the right-bank-descending of East Fork Poplar Creek. The cliffs along this zone are very intermittent and short. They too are dry. The soils on the upper banks are deep. The 1943 aerial photograph indicates the surrounding area was mature forest in 1943. Here too, the vegetation community of the upper banks was similar to the surrounding forest. There are no indications of this area being disturbed since the government acquired the property. No observable changes occurred during 2004.

Another limestone cliff was described in the baseline report (DOE 1997) as being in a steep curve along the right-bank-descending of East Fork Poplar Creek. Portions of this area were in cultivation to the upper margin of the cliff prior to 1943. Much of this cliff face was wet from seeps and periodic flooding of East Fork Poplar Creek. However, there is a gradation of moisture saturation and sunlight intensity from bottom to top. This has resulted in several strata of plant community types. These have resulted in an ecocline progression from high concentrations of moss, lichen, and algae on the bare rock surfaces near the bottom to oak-maple forest at the top. No development has occurred along East Fork Poplar Creek upstream of, or in the vicinity of this cliff. No observable changes have occurred in the plant communities along this limestone cliff since the baseline studies were conducted in 1996.

#### 4.6.3 Limestone Barrens

The baseline study (DOE 1997) described a single limestone barren from observations made in 1996. A second area designated as a limestone barren was referenced in the Environmental Assessment (DOE 1996A). Conditions for both are probably man-induced due to previous farming and logging practices. In the summer of 2004 the boundaries of both remained difficult to delineate because there was a gradual change in soil thickness and underlying geology accompanied by an irregular progression of changes in vegetation. No observable changes occurred during 2004.

#### 4.6.4 Canebrakes

Canebrake communities are composed of understory and forest floor vegetation within the bottomland forest community throughout the foothills of Appalachia. These canebrakes have been reduced by 95 percent, largely due to free-range livestock, drainage, conversion to agriculture, and fire suppression (Grossman et al. 1994). The Environmental Assessment (DOE 1996A) stated the canebrake communities along East Fork Poplar Creek were the most extensive on the Oak Ridge Reservation at that time.

Forested canebrakes were reported in various locations along floodplains of East Fork Poplar Creek and its tributaries in the Environmental Assessment (DOE 1996A) and the baseline studies (DOE 1997). The canebrakes exist as discrete patches in a bottomland mosaic. In 2004, canebrakes were seen throughout the floodplains on the Horizon Center. Other than the two locations where bridges cross the East Fork Poplar Creek floodplain, there has been no direct disruption of canebrake habitat. Clearing of vegetation at those bridge crossings resulted in more

light reaching the forest floor at the margin of the right-of-way. This has resulted in expanded populations and vigor of local cane.

#### 4.6.5 Walnut Plantations

Two walnut plantations were planted prior to 1977. Walnut Plantation 1 is located within the floodplain of East Fork Poplar Creek and Walnut Plantation 2 is upland and borders the North Perimeter Road. No changes observable occurred during 2004.

#### 4.6.6 Threatened and Endangered Plant Species

The baseline study (DOE 1997) reported the presence of five plant species having state or federal protection on the Horizon Center. During the late spring and early summer of 2002, protection zones were established around each area where these were reported. Each site was evaluated during each scheduled visit.

#### 4.6.7 Yellow Lily and Golden Seal Populations

Populations of yellow lily (*Lilium canadense*) and golden seal (*Hydrastis canadensis*) are located in hardwood dominated mesic forest on limestone slopes adjacent to Walnut Plantation 1. The slope has approximately 10-percent exposed limestone. There has been sufficient seepage to keep the soils moist in the earlier portion of the growing season. The area is bounded on the bottom of the slope by the floodplain of East Fork Poplar Creek and on the top of the slope by a former pine plantation that is now in secondary succession.

Approximately 150 golden seal were observed and most were located on the lower half of the slope. In 2002 there were approximate 200 yellow lilies intermingled with the golden seal. In 2003, the population of yellow lilies had increased to approximately 500 plants. In 2004 the populations of both were approximately the same as in 2003. Much of the area had been subjected to flooding during the winter and early spring. Thus the plants observed were from vegetative sources.

#### 4.6.8 Additional Golden Seal Population

The slope that supports the golden seal and yellow lily continues to the northeast and provides habitat for a moderate population of golden seal. Historically the 20-30 percent slope was too steep for agriculture; thus, it was wooded at the time of government acquisition.

The slope has a narrow hardwood dominated mesic forest bounded at the top by a red cedar-pine second growth forest and at the bottom by Walnut Plantation 1. The understory is sparse and is composed of sugar maple, American elm, and dogwood. The herbaceous layer is also sparse with such plants as wild ginger, Jacob's ladder, Virginia creeper, trillium, and poison ivy.

The slope has approximately 20-percent exposed limestone and thin soils over limestone. Portions of the slope have sufficient seepage to keep local soils moist in the earlier portion of the growing season. However, most of the slope dries quickly. The open canopy allows filtered light on the forest floor during much of the day.

Approximately 25 small plants were observed over an area approximately 100 meters by 10 meters during 2002. The population was estimated to be double that in the spring of 2003 and 2004. In addition, the distribution has spread up-slope where many flowering and fruiting plants are in close proximity to rock outcrops and fallen timbers.

#### 4.6.9 Pink Lady Slipper Population

A large population of pink lady slipper (*Cypripedium acaule*) was found on the left-bank-descending along the lower portion of East Fork Poplar Creek in June of 1996 (DOE 1997). The site was adjacent to a pine plantation that has been devastated by the pine beetle. As reported in 1997, many of the trees were dead and fallen with the early stages of succession underway. The probability for survival of the lady slipper was stated to be marginal.

The pine beetle infestation killed the surrounding pine forest over the last five years. The investigations in 2002 (DOE 2003) found secondary succession had produced a dense cover of low-lying invasive vegetation. Observations in 2003 indicated the primary succession had increased in density. The extent and density of this invasive vegetation has sufficiently altered habitat conditions such that survival of lady slipper is unlikely. No lady slippers were found in 2004.

#### 4.6.10 Beak Rush Community

The beak rush (*Rhynchospora colorata*) community could not be located during the 2004 study due to insufficient location description in the baseline study.

#### 4.6.11 Ginseng Population

The ginseng (*Panax quinquefolius*) community could not be located during the 2004 study due to insufficient location description in the baseline study.

#### 4.6.12 Cave Entrances

The EA (DOE 1997A) and the baseline study (DOE 1997) reference a cave entrance along North Perimeter Road. In early winter 2004, the entrance of the cave was open and not obstructed. During late winter and spring the drainage leading to the cave entrance was filled with forest debris as a result of severe storms. These were cleared in the early summer and remained clear for the remainder of 2004. The surrounding vegetation is primarily privet and Japanese honeysuckle.

#### 4.6.13 Springs

The EA (DOE 1996A) and the MAP reference two springs in the lower reaches of the East Fork Poplar Creek floodplain. These, plus an additional spring, were located and marked in 2002. All of these produced large flows of clear water throughout the year. Each is in protected coves with small surface watersheds; thus, their downstream flows are not impacted by surface conditions. Each are extensively used by wildlife as indicated by large numbers and diversity of animal

tracks around their perimeters during each season of 2004. There were no observable changes in 2004.

#### 4.6.14 Sinkholes

Several small sinkholes and one large sinkhole are on the Horizon Center. The only one of these inspected was the large sinkhole along the North Perimeter Road. In 2004 the area continued to be in secondary succession. Privet, green ash, and box elder are the dominant vegetation in the bottomland. The uplands have amore mature forest with box elder and green ash being the dominant trees.

#### 4.6.15 Wetlands

All known wetlands are in protected Natural Areas. Several wetlands were observed for signs of stress or impact from external influences during all seasons of 2004. All appear to be healthy and are being used by wildlife.

#### 4.6.16 Buffer Zones

Buffer zones around the Horizon Center, Natural Areas, sensitive areas, and cultural resources were examined during each season of 2004. There were no encroachments or need of special maintenance found.

### 4.7 Game Species

Only casual observations of game species were made in 2004. Thus, no attempts were made to quantify populations of rabbits (*Sylvilagus floridanus* and *S. aquaticus*), White-tail Deer (*Odocoileus virginiana*), Wild Turkey (*Meleagris gallopavo*), Wood Duck (*Aix sponsa*), Mallard Duck (*Anas platyrhynchos*), Ruffed Grouse (*Bonasa umbellus*), and Northern Bobwhite (*Colinus virginianus*).

Rabbit – The Eastern Cottontail (*S. floridanus*) appears to be increasing due to the increase of open land and succession. They, or their signs, have been sighted in all areas of the Horizon Center. Swamp Rabbit (*Sylvilagus aquaticus*) was reported for the first time in 2002 (DOE 2003). The Swamp Rabbit was seen again in 2004.

White-tail Deer – In the baseline study (DOE 1997) the White-tail Deer population was roughly estimated at one deer per 15 acres of land. The estimate was based on the hunting records for the Oak Ridge Reservation in general, and may have been low for the high carrying capacity at the Horizon Center. No deer hunting was permitted during the past seven hunting seasons; therefore, no recent harvest records were available.

Observations in all seasons of 2004 indicate White-tail Deer are common at the Horizon Center. Deer moved over most of the parcel. Tracks of buck, doe, and young were observed in roadways, clearings, and around water holes. Several doe with young were observed during the summer and fall months; thus, indicating a viable breeding herd of White-tail Deer on the Horizon Center in 2004.

Wild Turkey – Wild Turkey were re-introduced into the Oak Ridge Reservation in the mid-1980s. At that time, the Horizon Center provided prime habitat for turkey production and the population quickly expanded. The secondary succession resulting from pine beetle destruction of timber reduced prime habitat at the Horizon Center and construction of infrastructure further reduced the acres of range that support the birds. However, the increased open area for building sites and infrastructure and the increased edge along boundaries between secondary growth and mature forest increased the quality of the habitat available.

Wild Turkey were seen throughout the Horizon Center in all months of the year. Several broods of young poult were observed during all seasons of 2004.

Wood Duck – Wood Ducks were very active along East Fork Poplar Creek and Bear Creek during the winter, spring, and fall of 2004. Single Wood Ducks were flushed along East Fork Poplar Creek from its entry to its exit of the Horizon Center and the permanently flooded wetland on the northwestern corner of the Horizon Center on each of the seasonal investigation visits. Pairs of Wood Ducks were flushed or sighted on water in these locations during the spring visits. At least two broods of young Wood Ducks were observed in the spring and early summer of 2004. Thus, the East Fork Poplar Creek at the Horizon Center continues to provide suitable year-round habitat for Wood Ducks.

Mallard Ducks - Mallard Ducks were not reported in the Partners in Flight surveys. However, they were sighted as incidentals during the winter and spring in the lowlands near the end of East Fork Poplar Creek. No young were seen.

Canada Goose - Canada Geese were observed in various locations on the Horizon Center throughout the year. A nesting pair occupied a nest site on a peninsula of high ground protruding into a wetland in the lower reaches of the East Fork Poplar Creek floodplain. This was near the site a pair reared young in 2003.

Northern Bobwhite – At least two coveys of Northern Bobwhite were observed in the spring and summer. One was in the open land to the east of Imperium Drive. The other was along powerline and road right-of-way through primary succession along perimeter road just west of State Route 95. Northern Bobwhite were also heard near the McKamey-Carmichael cemetery.

Northern Bobwhite has been considered to be a declining species on the Oak Ridge Reservation (DOE 1997). There were none reported on the Horizon Center in the 1999 census, and the bobwhite population in 2000 was less than reported in the baseline study. While not common, Northern Bobwhite were observed in several locations on the Horizon Center in the spring and summer of the last four years.

#### **4.8 Non-Game Mammals**

Gray Fox – Common Gray Fox (*Urocyon cinereoargenteus*) were sighted near the eastern end of perimeter road on two occasions in the spring of 2004. The Common Gray Fox feeds heavily on cottontail rabbits, mice, voles, other small mammals, birds, insects, nuts, and berries which are abundant on the Horizon Center.

Bobcat – Bobcat (*Felis rufus*) were sighted as it crossed the perimeter road near the McKamey-Carmichael cemetery. While this is the only sighting of Bobcat, tracks were seen along stream banks and around springs.

Striped Skunk – Striped Skunk (*Mephitis mephitis*) were seen on the perimeter road near the juncture of Bear Creek and East Fork Poplar Creek and on Renouvaré Boulevard near the visitors center.

Virginia Opossum - Virginia Opossum (*Didelphis virginiana*) were seen in several location in the floodplains on the Horizon Center.

Raccoon – Raccoon (*Procyon lotor*) tracks were seen in numerous locations along stream banks, wetlands, and springs on the Horizon Center. They are normally active at night, thus, they are seldom seen during daytime investigations.

Muskrat – Muskrat (*Ondatra zibethicus*) middens and slides were found in several locations along East Fork Poplar Creek. They are most common in the low swampy areas on the eastern end and the western end of the Horizon Center. The muskrat is very secretive; thus none were seen.

Beaver – Beaver (*Castor canadensis*) is very common on the Horizon Center. While they are most active during the night, several were seen during daytime investigations. The highest concentrations are in the low swampy areas on the eastern end and western end of the Horizon Center. They are also numerous near the confluence of Bear Creek and East Fork Poplar Creek. They cut down considerable quantities of trees along the shores and, in some cases, at some distance from the banks. This allows sunlight to penetrate to the forest floor and stimulates primary invasion plant growth. Unfortunately this is often such exotic plants as privet.

## **5. CULTURAL RESOURCES**

All known cultural resources at the Horizon Center continued to be protected. The 100-foot buffer placed around the McKamey-Carmichael and Silvey cemeteries has been maintained.

Mill sites 40RE195 (975C) and 40RE200 (939B) along East Fork Poplar Creek, including 100-foot buffers, were marked as a precaution to encroachment in 2002. They were not disturbed in 2004.

In 2003 two millstones were found in East Fork Poplar Creek at 40RE200 (939B). These remain in place in 2004.

## 6. ENVIRONMENTAL PERMITS

No environmental permits were required.

## 7. REFERENCES

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