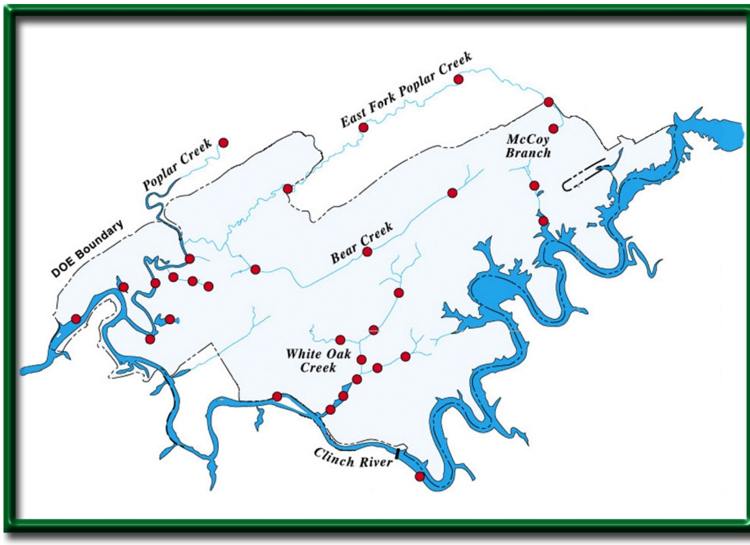
Aquatic Recovery
on the Oak Ridge National Environmental Research Park

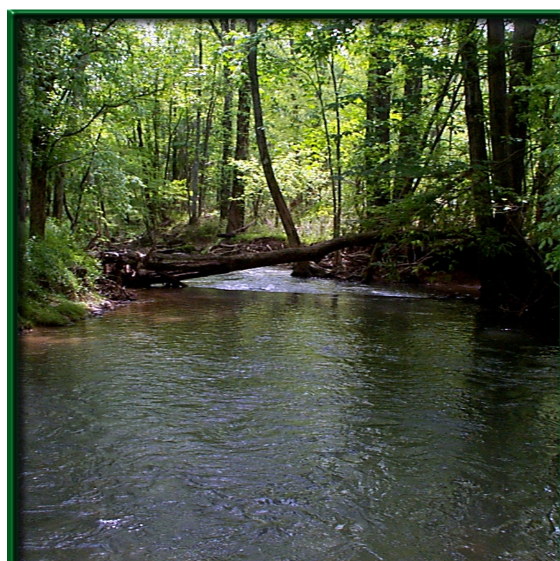


Streams on the Oak Ridge Reservation (ORR) near Oak Ridge, Tennessee (see map), have been adversely affected by operations of the U.S. Department of Energy (DOE) facilities for more than 50 years. Following a series of inspections, audits, and reviews by state and federal regulatory agencies in the early 1980s, efforts were initiated to bring these facilities into compliance with all applicable environmental regulations. The Biological Monitoring and Abatement Program (BMAP) was established in 1985 to assess compliance with the Clean Water Act and to help identify causes of adverse ecological impacts.

East Fork Poplar Creek

BMAP monitors many ORR streams through a multidisciplinary approach that includes ambient and effluent toxicity testing, bioaccumulation studies, assessment of individual health and reproductive competence of aquatic indicator species (bioindicators), and community surveys of periphyton, benthic macroinvertebrates, fish, and waterfowl. Integrating the results of these approaches, BMAP assesses the degree of recovery in streams on the ORR. In this sense, "**recovery**" refers to the return of the stream's water quality, physical structure, fauna, and flora to the conditions that probably would have existed in the absence of the DOE facilities.

Recovery is a long-term process, during which ORR streams are monitored and compared with area reference streams that do not receive industrial discharges.

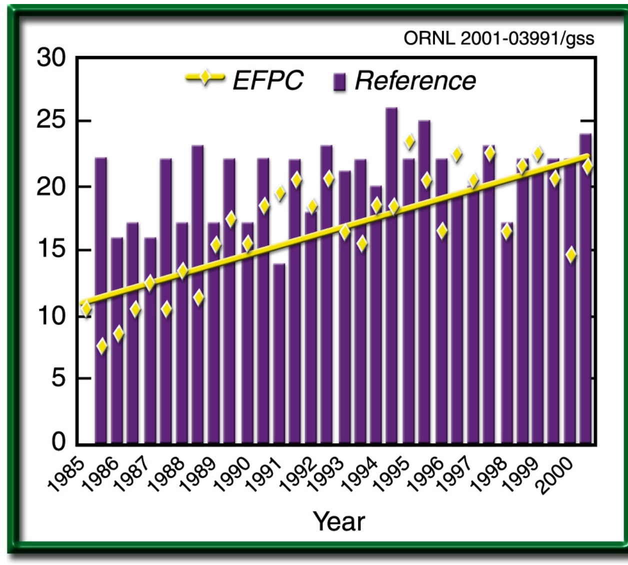


Poplar Creek

A number of ORR streams have shown dramatic recovery in recent years. One example is **East Fork Poplar Creek** (EFPC), which originates within the Y-12 National Security Complex (photo above) and flows through urban and commercial areas in Oak Ridge before entering the ORR, where it joins Poplar Creek (photo right). In the mid-1980s, effluents containing high levels of mercury and other metals, organic contaminants (e.g., PCBs), and chlorine were discharged into EFPC, and the temperature of the effluents was elevated. The stream was physically disturbed through the removal of stream side vegetation, channelization, and replacement of natural stream channels with concrete. Initial stream surveys indicated that fish and macroinvertebrate communities were significantly reduced near the Y-12 Complex. Notably, more sensitive fish (e.g., darters) and invertebrates (e.g., mayflies) were limited in number or absent. Adverse impacts on EFPC biota extended downstream as far as 17 km; biotic communities in these lower stream reaches were less diverse than those of reference streams but more diverse than communities in EFPC immediately below the Y-12 Complex. In addition to these community-level indicators, other parameters indicated adverse impacts: low survival of stream organisms in the laboratory and in situ bioassays of effluents and stream water, elevated levels of mercury and PCBs in fish, and stress and lowered reproductive capacity in individual fish.

Mayfly larvae

Over the past 15 years, many remedial actions have been implemented, such as new wastewater treatment facilities, dechlorination of outfalls, and reduction of mercury in effluents. As a result, the water quality of EFPC has improved. Better water quality has led to a greater abundance and diversity of fish (see graph) and macroinvertebrates, including higher numbers of the more pollution-intolerant taxa. Recovery continues throughout the stream, from the headwaters to the lower reaches of EFPC, where the biotic communities are similar to those of reference streams.



Number of fish species

Remedial actions at other sites have also resulted in the recovery of several receiving streams. **Mitchell Branch**, which flows through the East Tennessee Technology Park, was transformed from a stream without fish in some reaches in 1988 to a stream supporting eight species in 2000. **McCoy Branch**, which received fly ash discharges prior to 1990, once had a severely degraded macroinvertebrate community and its fish exhibited high levels of selenium contamination and accompanying bone deformities. Three years later, the stream contained a diverse macroinvertebrate community, lower levels of selenium bioaccumulation, and no deformed fish. Similarly, upper **Bear Creek** in 1985 had a transient fish population and few macroinvertebrates because of leachate from waste disposal ponds in the headwaters. BMAP sampling in 1997, however, showed well-established faunal communities in the creek, including a state protected species, the Tennessee dace. After waste ponds were capped in 1989, the reductions of in-stream toxicity and conductivity were matched by recovery of the biotic communities.

Tennessee dace (photo by R. T. Bryant)

These widespread improvements in the ecological health of streams on the ORR are evidence of the value of remedial actions and the benefits of improved wastewater treatment facilities.

For more information about stream recovery indicated by BMAP, please contact Jim Loar (865-574-7323; loarjm@ornl.gov) or visit the BMAP Web site at http://www.esd.ornl.gov/BMAP/.