1st Annual

State of the Stream Report
French Creek, Pennsylvania

2003

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MISSION

Western Pennsylvania Conservancy's mission is to save the places we care about by connecting people to the natural world.

ACHIEVING OUR MISSION IN FRENCH CREEK

Since the 1950s, Western Pennsylvania Conservancy (WPC) has recognized the uniqueness and need to protect the glacial region of northwest Pennsylvania for future generations to enjoy. Home to significant geological, archaeological, and ecological resources, this region holds treasures found nowhere else in the Commonwealth.

Even in those early days, WPC scientists recognized the significance of the French Creek watershed. This river system held the highest degree of biodiversity found anywhere in the northeast U.S. and became a priority project area for WPC. The first land protection efforts began in the 1960s with acquisition of rare wetland communities that would become a National Natural Landmark, the Wattsburg Fen Natural Area. Scientists from WPC worked with other conservation organizations like The Nature Conservancy to raise awareness of French Creek, an effort that lead to its inclusion in the TNC publication, *Rivers of Life.* WPC continued its scientific research in the French Creek watershed and in 1995, to further accomplish its mission, joined with the Pennsylvania Environmental Council and Allegheny College to form the French Creek Project, a nationally recognized community education and outreach endeavor to further raise awareness of French Creek and connect its watershed residents to this natural treasure.

In 2000, as a way to better engage with French Creek watershed communities and more thoroughly study the creek, WPC established its Northwest Field Station in the watershed. As a partner in the French Creek Project, WPC completed the comprehensive French Creek Watershed Conservation Plan in early 2002. This provided, for the first time, a blueprint for environmental education, conservation, and restoration of French Creek. Today, Western Pennsylvania Conservancy continues its efforts to better understand the processes governing the French Creek watershed and our impacts on water quality, aquatic biodiversity, and human quality of life. We are working with our partners in the French Creek Project, County Conservation Districts, local governments, environmental agencies, and conservation organizations to engage landowners in voluntary, incentive-based conservation practices, and we are striving to ensure important community decisions have sound, scientific data to inform them.

Western Pennsylvania Conservancy and many of our partners, including French Creek Project, The Nature Conservancy, County Conservation Districts, USDA Natural Resource Conservation Service, Conneaut Lake/French Creek Valley Conservancy and others are committed to protecting the rural, agricultural heritage of French Creek communities. This is evident in the hundreds of thousands of dollars raised by these organizations to assist farmers to implement Best Management Practices. Furthermore, WPC and our partners have worked diligently to expand programs like the Conservation Reserve and Enhancement Program (CREP), Growing Greener, and landowner incentive programs that could mean millions of dollars in support for French Creek farmers. Projects like this French Creek watershed assessment are crucial to understanding human impacts to our aquatic resources. This report will be a useful tool in leveraging much of the funding needed to work cooperatively with French Creek's agricultural community to protect French Creek's amazing natural resources and its watershed residents' rural quality of life.

The ***2003 State of the Stream Report on French Creek*** is the first of an annual report we plan to make to the communities of French Creek. We hope information such as this can help us to achieve our mission of connecting people to this special place. As an annual report, WPC pledges to continue engaging our partners in conservation and updating the public on the health of this watershed. In French Creek, we are striving to protect this place we care about by connecting people to its natural wonders.

ACKNOWLEDGEMENTS

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Western Pennsylvania Conservancy would like to thank staff from our partners at French Creek Project, The Nature Conservancy, Venango and Crawford County Conservation Districts, and the Pennsylvania Department of Environmental Protection who provided input on sampling design, assisted with rain or water sample collection, or assisted in any of the various fieldwork components. Also important to the success of this project were many competent student interns and volunteers from local universities and the Student Conservation Association. Annie Young-Mathews, Erica Maynard, Amy Bush, Chris Larson, Curtis Stumpf, and Dave Homans provided crucial assistance in the office, field, and laboratory.

Western Pennsylvania Conservancy would like to extend a special thank you to the volunteer water quality monitors from the French Creek Pennsylvania Senior Environmental Corps (PASEC) in Crawford and Venango counties. These dedicated individuals met with WPC staff prior to spring rain sampling and agreed to assist with water sample collection. This required expert planning and coordination of several teams, as well as a little help from Mother Nature. On April 14th, 2002, these volunteers received the last minute call that weather conditions were right and sampling needed to happen. Along with WPC staff, these volunteers visited and sampled 105 sites throughout the French Creek watershed during a 12-hour period in heavy rains. Without the help of these volunteers, this project could not have succeeded and WPC is proud to partner with individuals so dedicated to conservation in French Creek.

Todd Sampsell and Tamara Smith
Northwest Conservation Programs
Western Pennsylvania Conservancy
February 2004

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INTRODUCTION

French Creek, originating in western New York and flowing 117 miles to its confluence with the Allegheny River at Franklin, Pennsylvania, is perhaps the most ecologically significant waterway in the state, containing more species of fish and freshwater mussels (Unionidae) than any other similar sized stream in the northeast United States. Over 80 species of fish and 27 native species of freshwater mussels are found in the watershed along with various other wildlife and plant species.

Two of the mussels found in French Creek are presently listed as Endangered under the U.S. Endangered Species Act, the northern riffleshell (*Epioblasma torulosa rangiana*) and the clubshell (*Pleurobema clava*). Thirteen other mussel species are considered rare, threatened, or endangered in Pennsylvania. Threatened or endangered fish include several madtom and lamprey species, as well as eight of the 15 species of darters found in the French Creek watershed.

There are a number of activities in the French Creek watershed such as agriculture, logging, mineral extraction, and development that may jeopardize water quality. Not only are these potential threats to aquatic organisms, but impacts from these activities may ultimately jeopardize the quality of life for watershed residents.

In this study, chemical, physical, and biological stream conditions were assessed throughout the watershed. It was our goal to identify potential threats and to be able to prioritize recommendations for restoration, maintenance, and protection of aquatic resources in the French Creek watershed. In doing so, the Western Pennsylvania Conservancy (WPC) and our partners can more effectively work in cooperation with landowners to avoid more stringent regulations on water quality impacts.

Study Location

French Creek is part of the Allegheny River watershed and therefore contributes to the Ohio River, the Mississippi River, and ultimately the Gulf of Mexico. The entire French Creek watershed covers an area of approximately 1235 square miles (790,400 acres). Approximately 93% of the watershed is within Pennsylvania, and the remaining 7% is made up of headwater streams in New York. The headwaters of the West Branch of French Creek and the French Creek main-stem form in Chautauqua County, New York and flow southwest to their confluence in Erie County, Pennsylvania. The South Branch of French Creek originates near Corry in Erie County and flows west to its confluence with French Creek west of Union City in Erie County. French Creek flows south through Crawford County, the northeast corner of Mercer County, and finally into Venango County where it flows southeast to its confluence with the Allegheny River at Franklin, Pennsylvania (Figure 1).

The French Creek watershed is mostly rural with only a few urban areas. The watershed is home to approximately 116,000 people, with the largest city being Meadville, PA (2000 Census). Although the landscape has various land uses, most can be categorized as either agricultural or forested (Figure 2).

Monitoring Design and Rationale

Sub-Basin Approach

The French Creek watershed can be divided into 11 major sub-basins with drainage areas greater than 50 square miles (Table 1, Figure 3), including the main-stem sub-basin. Sub-basins provide a useful way to visualize entire watersheds in smaller, more manageable units. These sub-basins vary in land-use, geology, etc. Species distribution and threats to natural resources may differ significantly between sub-basins as well. Therefore, it is likely that the approach for natural resource restoration, maintenance, and protection will be different for each sub-basin. Because of these reasons, this study employed a sub-basin approach as a way to target problem areas in the French Creek watershed.

In this study, we attempt to prioritize sub-basins based on their impacts to the main-stem river. To do this, we summarized physical habitat, land-use, water quality, and macroinvertebrate data for each sub-basin.

Macroinvertebrates

Evaluation of macroinvertebrate communities is a critical component in the biotic evaluation of water quality. Since stream water is constantly moving, physical and chemical measurements made at a certain point in time may not show signs of pollutants that have previously moved down-stream of the sample site. Because stream macroinvertebrates are less mobile than fish and have a 1+-year life span, they can serve as natural, continuous water quality monitors. Many macroinvertebrates are sensitive to long-term, low-level stress and/or pulsed, highly concentrated discharges of water pollutants. Because of these qualities, many environmental monitoring agencies employ macroinvertebrates to assess biotic integrity of stream ecosystems (EPA 1999). Several metrics for evaluating benthic macroinvertebrate data were utilized in this study; including taxa richness, taxa composition, and tolerance indices.

Richness and composition metrics reflect the diversity of the assemblage, which reflects the amount of food, habitat and niche space available to propagate many species. Taxa richness is the total number of distinct taxa within a site. EPT taxa richness is the total number of distinct taxa within the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Tricoptera (caddisflies). Composition metrics were also calculated, including the percentages of EPT taxa, Ephemeroptera, Plecoptera, Tricoptera, Diptera, and Chironomidae. For the orders Ephemeroptera, Plecoptera and Tricoptera, the expected response to increasing disturbance is a decrease in number of taxa and decrease in percent composition. EPT taxa are a good measure of stream degradation, as they are generally considered more sensitive to disturbance than the other macroinvertebrate orders. Chironomidae and other Diptera are expected to decrease in number of taxa, but to increase percent composition with increasing perturbation (EPA 1999, Barbour et al. 1996).

Tolerance indices reflect on the amount and/or type of pollution in the system. We utilized the Hilsenhoff Biotic Index (HBI), where each macroinvertebrate family is assigned a tolerance value based on tolerance to organic pollution (Hilsenhoff 1988). The tolerance values range from 0-10; the lower scores signify organisms that are more

Figure 1: Location of the French Creek watershed

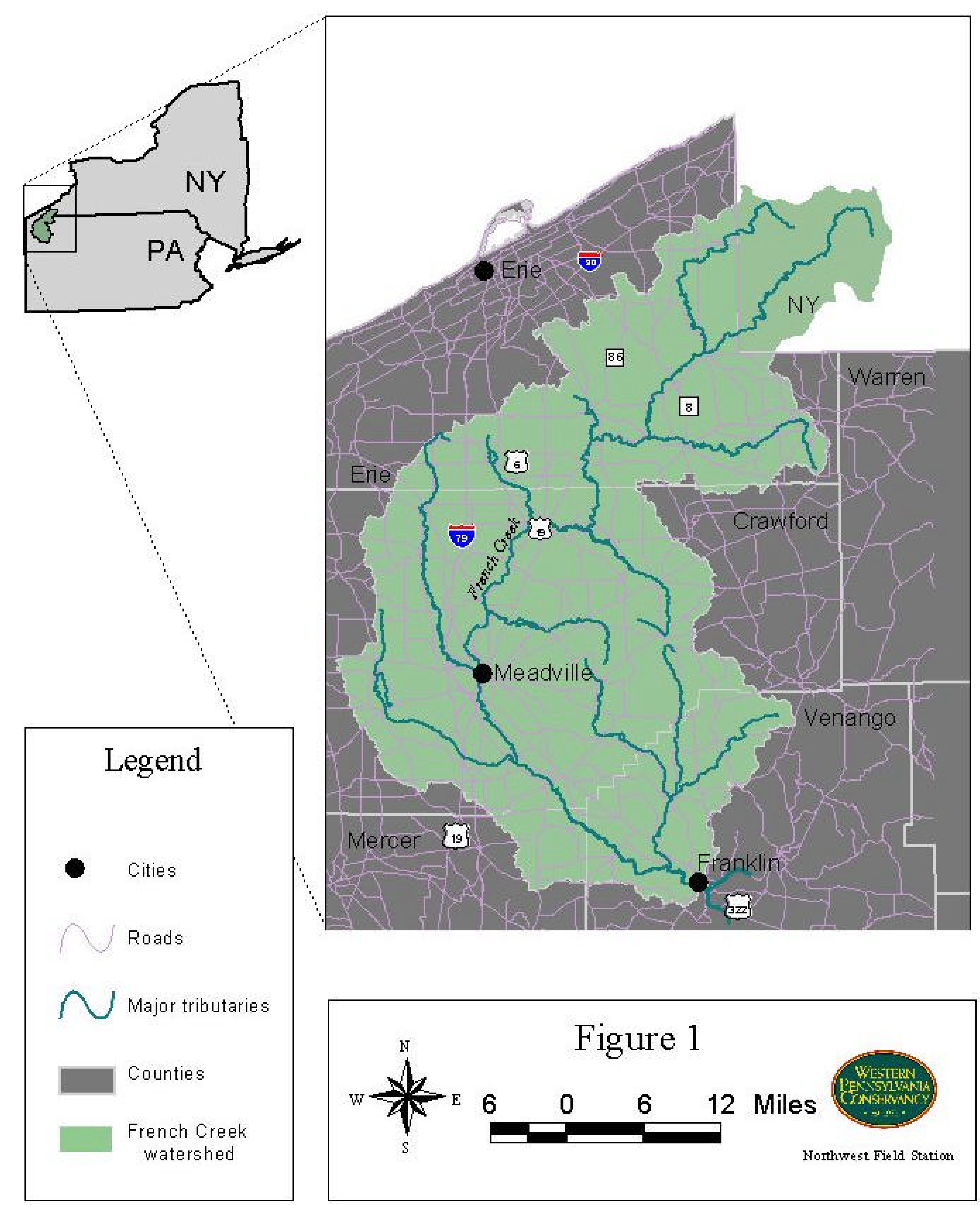


Figure 2: Land-use in the French Creek watershed

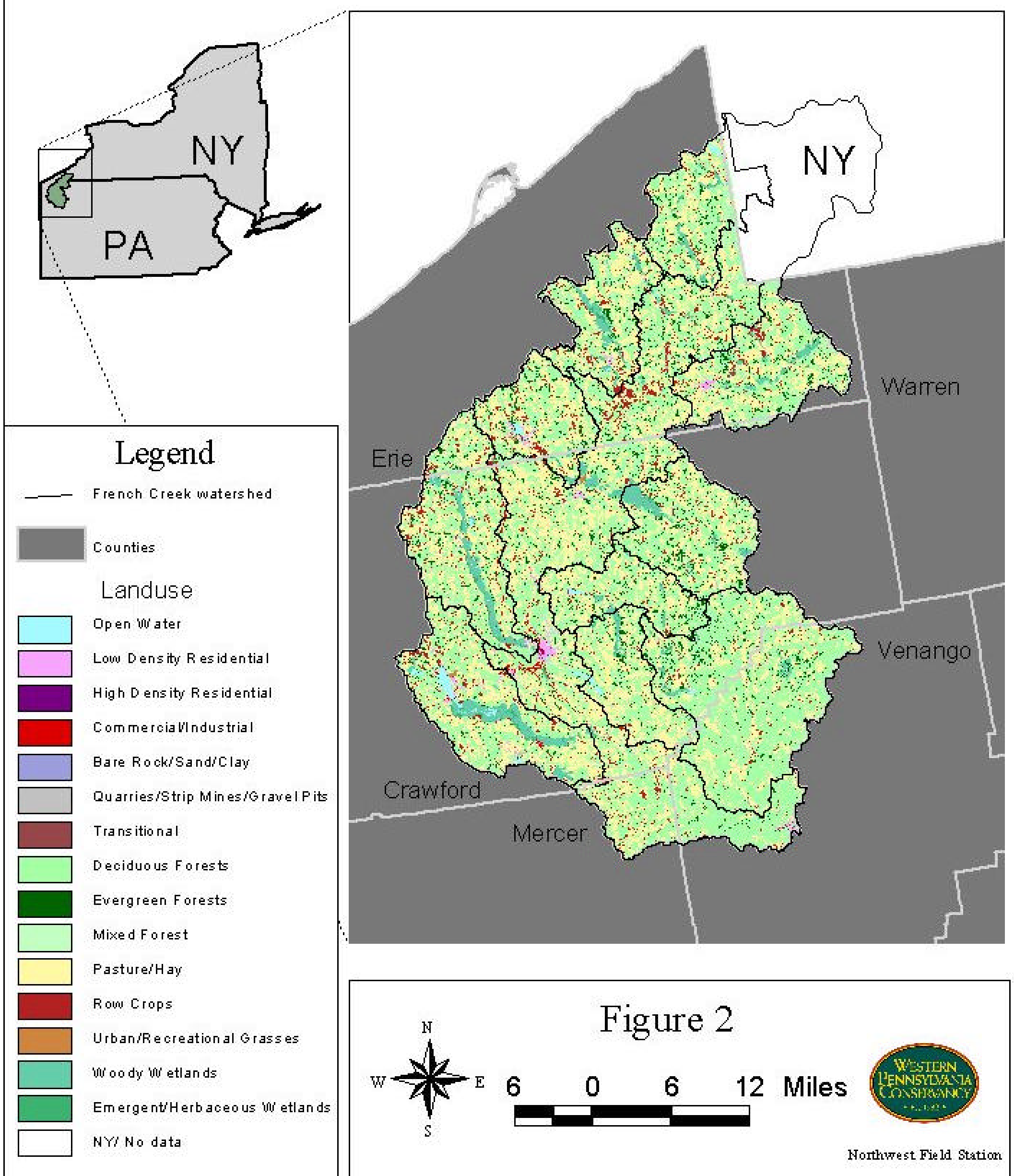


Figure 2

Table 1: Major sub-basins (>50 mi^2) in order from the upstream most to the downstream most confluence with the main stem of French Creek, with description of their confluence location. Included is the total area in acres and area defined as forested and agricultural land. Similar description of the main-stem sub-basin is also included.

Sub-Basin Name	Area (acres)	Agriculture (acres)	Forest (acres)	Confluence Location
West Branch French Creek	34,840	12,694	19,863	Originates in Chautauqua County, New York and joins the main branch of French Creek at Wattsburg, Erie County, PA
South Branch French Creek	52,799	20,778	28,942	Originates near Corry, Erie County, and joins French Creek west of Union City, PA
Le Boeuf Creek	40,634	18,172	18,522	Flows through Waterford, drains Lake Le Boeuf, and joins French Creek near the village of Indian Head, PA
Muddy Creek	48,670	18,085	27,460	Flows through the Seneca Division of the Erie National Wildlife Refuge and joins French Creek near the village of Miller's Station, Crawford County, PA.
Conneauttee Creek	35,351	15,928	17,509	Enters and drains Edinboro Lake, flows through Edinboro, Erie County, and joins French Creek near Cambridge Springs, Crawford County, PA.
Woodcock Creek	32,606	12,830	18,548	Dammed by the United States Army Corps of Engineers (USACE) to form Woodcock Creek Lake, joins French Creek near Saegertown, PA.
Cussewago Creek	62,558	24,168	31,184	Joins French Creek at Meadville, PA.
Conneaut Outlet	64,518	24,249	29,794	Drains Conneaut Lake and joins French Creek south of Meadville, PA.
Little Sugar Creek	33,791	15,107	17,329	Joins French Creek at Cochranton, PA.
Sugar Creek	107,410	29,205	76,243	Joins French Creek at the village of Sugarcreek, Venango County, four miles upstream from the mouth of French Creek at Franklin, PA.
		82,610	116,884	Starting at NY border and ending at the mouth of French Creek at

French Creek main	207,732	Franklin, PA.

sensitive to organic pollution than higher rated organisms. Thus, a low HBI score indicates better stream conditions than a high score. The HBI is the average tolerance value of all the individual organisms within the sample weighted by the abundance of each family. We assigned tolerance values according to those the Pennsylvania Department of Environmental Protection generated for their Unassessed Waters Program (PADEP 1999). Additional values came from EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (1999).

Macroinvertebrate community structure was determined by sampling 49 randomly selected stream sites from locations within the French Creek watershed (Figure 3). Three to five sites were sampled in each of the 10 major sub-basins and 13 sites were sampled in the main-stem sub-basin. The macroinvertebrate community was sampled and evaluated using metrics and procedures modified from EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (1999). Sampling was standardized to 1-minute kicks with a standard D-frame net for 5 sub-samples within each site, which were pooled together for site totals. Different habitat types were sampled in approximate proportion to their surface area in the study reach. Collected macroinvertebrates were placed in 75% ethanol for transport to the lab where they were transferred to 95% ethanol and identified to order level. Macroinvertebrate data were also summarized for each sub-basin and analyzed with their associated water quality, land-use, and physical habitat parameters. To account for varying life stages, macroinvertebrates should ideally be sampled within the same season. When interpreting the following data, one should note that 32 sites were sampled in the spring and the remaining 17 were sampled in the fall of 2002.

A sub-set of macroinvertebrates from 19 random samples were identified to genus level and examined in further detail. All of the samples used in the genus level analyses were taken between 8-May and 23-May 2002.

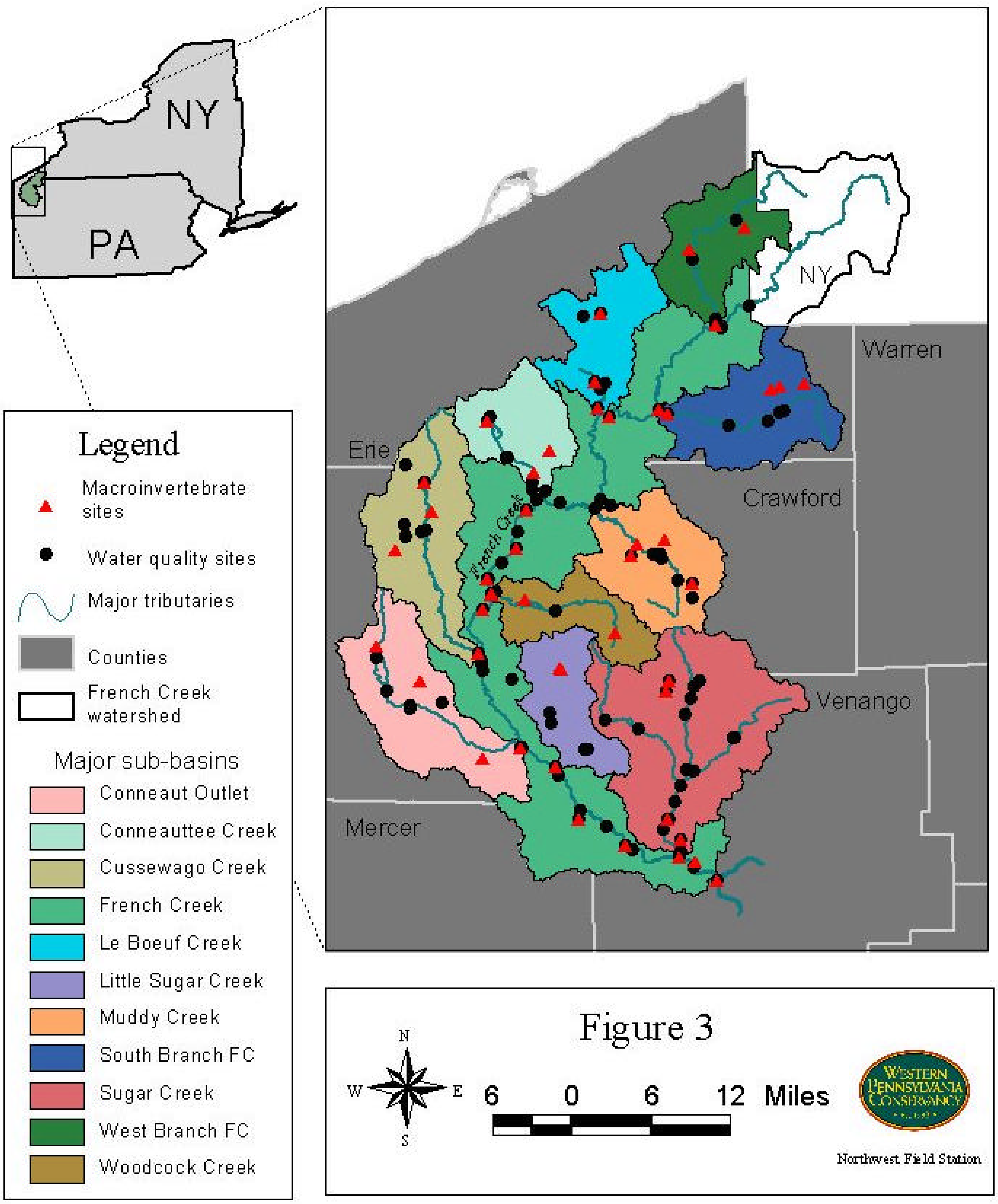
We calculated percent EPT taxa and percent Diptera to evaluate macroinvertebrate communities at all 49 sites. At the 19 sites where generic level data was available, we calculated Ephemeroptera, Plecoptera, Tricoptera and total EPT taxa richness at the family and generic levels. Percentages of Ephemeroptera, Plecoptera, Tricoptera, Diptera, and Chironomidae were calculated for each of the 19 sites. HBI was also calculated for these sites.

Water quality

Macroinvertebrate community analysis alone cannot ascertain exactly the type of pollutant entering stream ecosystems. Therefore, other types of analytical procedures, such as water quality testing, are necessary to complete the picture. Because the French Creek watershed is a highly agricultural area, we suspect nutrient loading and sedimentation as potential threats to aquatic communities, particularly freshwater mussels and darters. Sewage treatment plants, urban runoff, industrial discharge, and other pollution sources in developed areas are also potential areas of concern. Water quality analysis is the first step to develop a nutrient budget for French Creek and would allow for a more efficient approach to the implementation of BMPs and riparian buffer restoration to combat nutrient runoff and loading of groundwater (French Creek Watershed Conservation Plan 2002).

Water quality was assessed at 106 sites in the French Creek watershed using both

Figure 3: Sub-basin delineation and study sites in the French Creek watershed



field and laboratory analyses (Figure 3). Field measurements were measured with a YSI 600 water quality meter and included temperature, conductivity, specific conductance, dissolved oxygen percentage, dissolved oxygen concentration, salinity, and pH. Water samples were collected at each of the sites and sent to Microbac Laboratories, Inc. (Erie, PA) for chemical analyses. These water samples were tested for concentrations of nitrogen, phosphorus, total dissolved solids, suspended solids, ammonia, kjeldahl nitrogen and biological oxygen demand.

The above field parameters and water quality samples were taken at each site during three time periods representing varying water level stages; during summer base flow, after a summer rain event and after a spring rain event. With the help of numerous volunteers stationed throughout the watershed, sampling during rain events occurred within a 12-hour time span to minimize temporal variance. We sampled while water levels were rising on the tributaries and main-stem, as verified by USGS gauging stations. We were only able to sample 28 of the 106 sites during the summer rain event.

For each sampling period, the mean values of water quality parameters for each sub-basin in the French Creek watershed were calculated. We used analysis of variance techniques to determine the significance of differences in water quality parameters between sub-basins. Regression and correlation analyses were used to determine relationships of water quality parameters with habitat, land-use, and macroinvertebrate data.

Water velocities and wetted widths were measured at 12 of the 106 sites during the spring rain event, 26 sites during base flow, and 11 sites during the summer rain event to calculate discharge, which allowed us to compute nutrient loading rates. We expected nutrient loading rates to be highest in the spring, revealing the effects of physical and chemical alteration from farming practices. High loading rates during the summer rain event would suggest additional sources, such as airborne pollutants.

At sites where discharges were calculated, nutrient concentration values were converted into nutrient loading rates. Loading rates will help determine the amount of nutrients each sub-basin (or site) is contributing to the main-stem of French Creek (and eventually the Allegheny and beyond). We compared the loading rates for sites at each sampling period to determine the timing and possible causes of high loading. We used regression analyses to model loading rates and to determine which sites fall out of expected patterns within the system.

In addition to in-stream water sampling, we collected rain samples at three sites during the spring rain event; Lake Pleasant, Meadville and Franklin. These sites represent the northern, middle, and southern regions of the watershed respectively. During the summer rain event we collected rain only from the northernmost site, Lake Pleasant. These rain samples were tested for concentrations of nitrogen, phosphorus, ammonia, organic nitrogen, and kjeldahl nitrogen.

Habitat Evaluations

In-stream and riparian habitat at each macroinvertebrate site were evaluated using DEP's modified EPA Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers (1999). Habitat/riparian evaluations were divided into two parts; the first dealing more with in-stream habitat and the second focusing on riparian conditions. Habitat/riparian score 1 equals the total number of points given from visual evaluations of in-stream cover, epifaunal substrate, embeddedness, velocity/depth regimes, channel alteration and sediment deposition. Habitat/riparian score 2 equals the total number of points given from visual estimations of riffle frequency, channel flow status, bank condition, vegetative protection on bank, grazing/other disruptive pressure, and riparian vegetative zone width. All parameters were rated on a numerical scale, ranging from 0-20, and increase as habitat quality increases. So, 120 is the highest possible for both scores 1 and 2. Scores 1 and 2 added together is denoted as the total habitat/riparian score. Habitat/riparian scores were summarized for each site and sub-basin and compared to associated macroinvertebrate communities, water quality, and land-use data.

Land-use

We utilized GIS spatial data to locate land-use factors physically impacting aquatic communities in French Creek. We were particularly interested in the percentage of land used for agricultural purposes versus forested land, and how this may impact water quality in the watershed. For this analysis, the French Creek watershed was delineated into 11 major sub-basins (Figure 3) and percent agriculture and forest was calculated for each sub-basin (Figure 4). We defined agricultural land as that covered by row crops or pasture/hay. Forested land included mixed forest, deciduous forest, evergreen forest and transitional forests. We used regression and correlation analyses to compare percentages of agricultural and forested land for each sub-basin to macroinvertebrate, habitat, and water quality data.

Main-stem habitat evaluation

Almost the entire length of the Pennsylvania portion of French Creek main-stem was mapped using GPS and GIS technology. Stream reaches were measured and categorized into one of 3 flow regimes; pool, run, riffle, or a combination of these regimes. Visual estimations of substrate types were noted for each reach. Gravel sized substrate in riffle and run flow regimes make up what is believed to be essential habitat to many freshwater mussels and fish of special concern in this watershed.

Additional features were mapped along the main-stem such as locations of discharge pipes into French Creek. Locations of muskrat middens, piles of empty freshwater mussel shells deposited by muskrats, were mapped as well.

At sites beginning below the USACE Union City Dam, observers stopped at approximate 0.5-1.0 mile intervals to perform in-depth riparian assessments developed at Pennsylvania State University (Schnier 2002, np). At these 55 sites, riparian area was assessed using visual estimation of the following: riparian buffer width, riparian vegetation type, riparian vegetation thickness, bank vegetation type, bank vegetation thickness, bank stability, water pathways, channel modification, canopy cover, in-stream cover, embeddedness, aquatic vegetation, and land-use. Total scores were converted to percentage out of a possible 100 percent. We analyzed these riparian assessments to make generalizations for the upper, middle, and lower portions of the main-stem channel.

A portion of French Creek, south of the Union City dam, was studied in further detail, to document the basic physical parameters of the stream including the geomorphology, sedimentology, and hydrology of the channel (Straffin 2003, Appendix A). This study provides a model that may be used as a reference for stream hydrologic monitoring efforts in the future.

Figure 4: Agricultural and forested land in the French Creek watershed