

This research will have two major goals: to assess consequences of exposure to a variety of hazardous materials produced by industries in an environmentally stressed region in Michigan and to develop methods and institutional structures to empower local residents to define medical responses to the exposure. Three adjacent communities in Gratiot County, Michigan, have been exposed to different industrial pollution over long periods in the Twentieth Century: DDT production from 1944-1963 and PBB production from 1970-1975 in St. Louis, volatile organic compounds from an oil refinery in Alma (1934 - 1999), and agricultural production with a potential fungi exposure in Breckenridge throughout the last century. Periodically, residents have been told of risks, enrolled in sporadic research projects, and then were ignored for significant periods, only to have renewed interest focused on them. In 1999, three emergency clean-up actions are underway or in litigation in the communities to remove tons of DDT, thousands of gallons of petroleum contaminated surface and ground water, and soils contaminated with products ranging from asbestos to radioactive wastes.

Community suspicion and outrage at the exposures in the region compelled the U.S. EPA in 1997 to allow formation of a community advisory group for watershed remediation. Previously, the communities had a passive role in partial containment of the superfund sites in the region and simply endured the odor and sight of pollutants. Suspicion about individual exposure and related health risks never were sufficiently addressed. The objective thus is, to conduct a population-oriented health risk-screening program with citizens' involvement that will result in information desired by the population and a long-term informational and educational structure to assure citizen input until satisfactory remediation is attained.

The Pine River watershed in northern Gratiot County Michigan has been an environmentally stressed community for more than a century, experiencing cycles of both growth and decline as a result of resource exploitation. In the first generation of European settlement, the region was deforested, accompanied by significant erosion and wild fires. As the forests were being depleted, the region tried to capitalize on mineral springs in the lower valley, northeast of Alma to create a resort center at St. Louis. However, soon the springs were tapped for more lucrative if less environmentally friendly uses (involving chemical processing), which destroyed the area's potential as a vacation site. Brine extraction from the mineral springs promoted the growth of the chemical industry (the former Velsicol/Michigan Chemical plant) and oil extraction around the region promoted the growth of several small refineries between Alma and St. Louis. As with forestry, however, extraction of resources was both so complete and so reckless that first the chemical plant (1978) and then the last refinery (1999) shut down.

At the time of each of these changes, the region experienced economic and social shocks due to environmental exploitation. The region's first settlers, the Saginaw Chippewa Indian Tribe lost most of their land, although retaining fishing rights on the river under the Treaty of the Saginaw, September 24, 1819 (7 Stat. 203). However, even those rights have been made meaningless by a complete fishing ban imposed on the river by state health officials in the 1970's. The owners and employees of the timber companies and then the tourist industry both lost their assets as a result of later changes. Then in the 1970's the closure of Velsicol Chemical deprived over 400 union members in St. Louis (population 4000) of their jobs. Beginning about the same time, Total Petroleum began a significant cut back in employment in Alma, associated with mergers in the oil industry and resource depletion. Headquarters moved from Alma to Denver in 1980. In the mid-1990's the other office operations of Total moved to San Antonio. In 1999, the last 250 refinery workers lost their jobs.

The target population consists of three adjacent communities in Gratiot County, Michigan, namely Alma, St. Louis, and Breckenridge (Figure 1). The population in the three communities totals about 14,000 residents, of which the majority are white and non-Hispanic origin (Table 1, data on Breckenridge was not available for 1970). About 180 children are born each year in the three communities and 730 children between age 7-10 reside in the three communities. St. Louis, Michigan, is the lowest income community of the three, and still suffers the ill-effects of the Velsicol plant closing in 1978.

**St. Louis** was from 1935 to 1978 the site of the Michigan Chemical Company, a subsidiary after 1963 of Velsicol Chemical of Chicago. Its production included inorganic products (MgO), rare earths, and a variety of halogenated organic products, such as DDT and, starting in 1971, the fire retardant PBB. In 1973 PBB was shipped instead to MgO for cattle feed. This contamination of cattle was discovered in 1974 and resulted in the shutdown of the plant in 1978. DDT levels in river sediments adjacent to the plant have been detected as high as 44,000 ppm (maximum safe level: 5 ppm). Fish from the Pine River (Figure 1) were highly contaminated with PBB and DDT. After congressional hearings (1976-78) and a consent judgement-agreement between the Michigan Department of Natural Resources (DNR), the U.S. EPA, and Velsicol in 1982, Velsicol was exempt from cleaning up the river. The company paid some restitution to farmers and to the state for plant site related studies and containment. Velsicol and its former parent company, Northwest Industries (NWI), are required to maintain a cap on the plant site and a containment system designed to stop the migration of PBB, HBB, DDT and other contaminants into the environment. A 2-foot thick, low-permeability slurry wall around the 52 acre-facility and a 3-foot thick, low-permeability, clay cap were built. In 1986 EPA designated the Velsicol plant site, the nearby county landfill, into which the company had dumped tons of contaminated wastes, and another site west of the plant as superfund sites. Under the 1982 Consent Judgement, Velsicol was freed of responsibility for the river contamination adjacent to its plant site. "Velsicol continued to pump water from the Containment System approximately every 6 months to maintain the required water level. Meanwhile the State collected fish samples in 1994 and noted an average concentration of total DDT in skin-off filet carp samples more than doubled since the last collection in 1989." Average concentration in 1989: 10.5 ppm, in 1994: 23.3 ppm, in 1995: 16.1 ppm. "The Agencies believe that the clay cap is leaking, probably due to the fact that there is no frost protection layer on top of the cap." "...EPA is aware that some local residents fish despite the no consumption fish advisory and there is a migrant farm worker population that comes to St. Louis every summer to live in camps and work on the surrounding farms. It is assumed that this population will fish the Pine River to supplement their diet."

**Breckenridge** has a population of about 1,300. The town contains one industry, a large bean and grain elevator since 1909. In 1974 a cluster of Hodgkin's disease was detected in Breckenridge. Four cases were determined between 1971 and 1973, six additional cases between 1954 and 1967. The age-adjusted average annual incidence was 12.2 times the expected rate. A study conducted by Schwartz et al. in 1976 indicated that antigenic exposure from bean dust might have induced the diseases. Potential chemical exposure from the Velsicol plant in this downwind community was - at that time - not taken into consideration. Another study by Zack from 1977, however, could not confirm that areas with navy bean processors in Michigan show a higher risk of Hodgkin's disease.

**Alma** has a population of about 9,000. East of the community are the sites of several oil refineries (most recently Total Petroleum, Inc., now Ultamar Diamond Shamrock, [UDS]). U.S. Environmental Protection Agency (EPA) Region 5 in 1998 brought suit against Total for violations of the Clean Air and Clean Water Acts. At the end of 1999, these violations are being settled through a consent agreement. In addition, hundreds of thousands of gallons of free product and benzene contaminated groundwater, as deep as 115 feet, is migrating off-site. The Pine River Superfund Citizen Task Force has had formal input (submitting a Supplemental Environmental Project), asking that the company be forced to clean the Pine River and an adjacent creek of contaminants. While a major concern in the community related to the refinery closing is the loss of jobs and health benefits by workers, many assume the odors and other exposures from the refinery cause health problems. Benzene, toluene, ethylbenzene and xylene were detected in significant amount in water samples. Exposure to sulfur dioxide can impair breathing, aggravate existing respiratory diseases like bronchitis, and reduce the ability of the lungs to clear foreign particles. People with chronic lung and heart diseases, the elderly, and children are the most sensitive. No studies have been conducted to assess the amount of exposure or health sequelae in this region.

#### **B.2.1. Risk communication and screening**

Residents of the region are resigned to the periodic powerlessness in the face of resource exhaustion, environmental contamination, corporate restructuring, and global economic trends. Perhaps the most extreme proof of this powerlessness is the willingness of many residents of the region to accept as inevitable the health problems which they believe grow from the contamination to which they have been repeatedly exposed. Velsicol and its predecessor Michigan Chemical dumped thousands of tons of DDT in the Pine River and other regions near St. Louis. Beginning around 1970, the company also exposed the residents and workers to rather uncontrolled PBB dumping and emissions as well as low level radioactive waste. Consequently, St. Louis has two active Superfund sites and a river with the highest levels of DDT ever documented in this country (up to 44,000ppm). Now the refinery, which has been added to the list for environmental remediation has associated with it groundwater and surface water contamination that is making its way off the plant site and downstream towards St. Louis. The refinery has, for the past two or three generations emitted a variety of volatile organic compounds (VOCs), semi-volatile organic compounds, heavy metals, sulfuric and hydrofluoric acids and other byproducts of oil refining into the air, groundwater and soil and surface waters of the local drainage basin. Residents of the region are resigned to experiences such as high levels of certain cancers, birth defects, and learning disabilities.

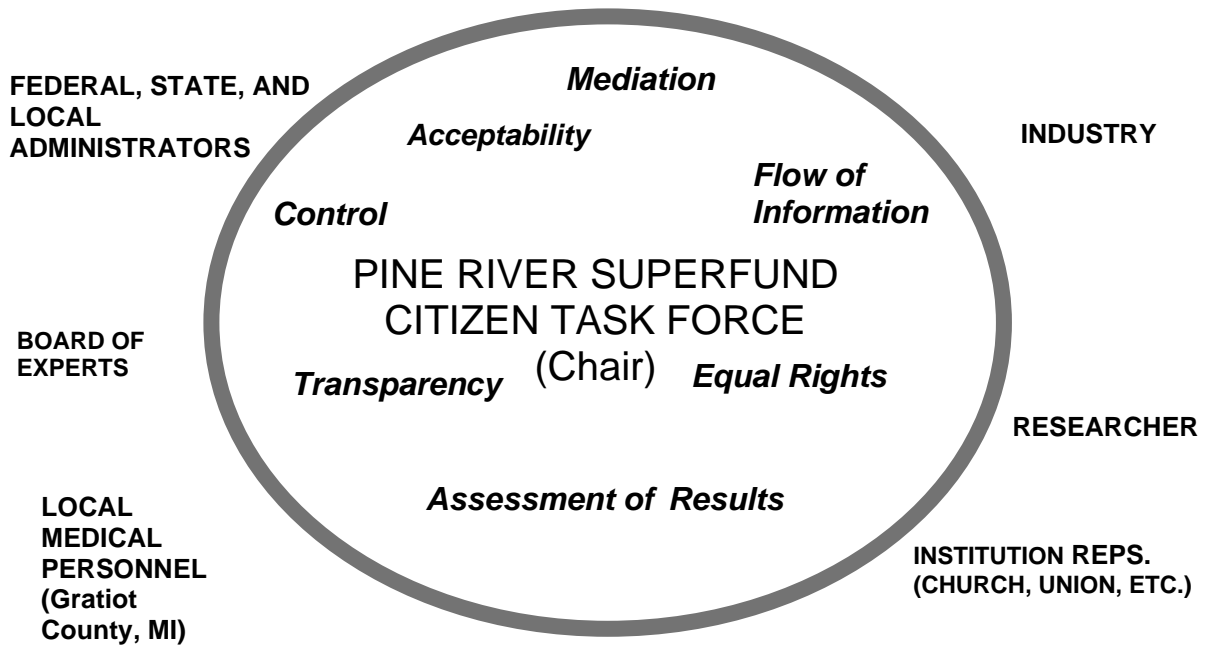
Emergency clean-up of the Velsicol DDT began in 1998 after a variety of investigations by both EPA and the Michigan Department of Environmental Quality (MDEQ) found levels of DDT/DDE in water and fish tissue rising. Well-attended public meetings regarding the clean up revealed widely shared resentment at previous decisions of the USEPA and the state regarding local hazards. This shared sense of indignation and frustration empowered the community in 1998 to form, under EPA regulations (OSWERD Directive 9230.0-28), the CAG, named the Pine River Superfund Citizens Taskforce. In addition to citizens not holding office or representing groups, the Taskforce includes city and county officials, members of conservation groups, representatives of the Chippewa Indian Tribe, and former workers from Velsicol and Total. MDEQ and US EPA staff responsible for the remediation attend all meetings and often are joined by representatives of the state Department of Community Health. Over the past year-and-a-half, the Taskforce leaders have been invited to brief the ministerial association in St. Louis, the public schools, civic organizations including the Rotary, Lions and women's clubs, students at area colleges and universities and area medical professionals. They also have presented status reports on the remediation to the county "Evening in the Park," summer lecture series and on public access TV in Gratiot and Midland Counties.

The Taskforce provides a model forum for communicating with residents about risks and learning from them possible sources of risks. Such communication can improve the effectiveness of any research about risks in the three communities. While the disadvantage of appropriate risk communication is documented for several studies, advantages are outlined by Kandt et al.:

1. Special information and data are available to concerned citizens and community activists that are unknown to outside experts. These people can provide hints on unknown routes of exposure and health effects and can guide inquiries of specific problems.
2. Recruitment for individual investigations and acceptance of findings, whatever their message is, are increased by community involvement.
3. Community involvement can identify special objectives of investigation, eases acceptance of investigations, and can therefore reduce costs.
4. Involved citizens can take control of key research functions. This can increase transparency of scientific decision making, the possibility of including diverse perspectives, and through independent commentary on research, enhance objectivity.

We suggest a model of cooperation as shown in Figure 2. A precondition is that the participants in the CAG or representatives of various groups have equal rights. The requirement to successful cooperation is to draw up binding rules for communication and ways of decision making, besides the allocation of responsibilities. The citizens should preside over meetings and keep the minutes, which document the statements of all participants, including the researchers

**Figure 2 MODEL OF COOPERATION**



Citizen members of the taskforce and the elected chairperson are inside the circle. Outside the circle are the key interests and specialists potentially needed by the citizens to understand risks.

- The chairperson must be without any conflict of interest. He/she is leading the discussion and is responsible that the rules are followed. Consequently, while he is involved in soliciting this grant, he will not receive any compensation.
- The Taskforce, open to all area residents, will represent the interests of exposed populations. The Pine River Superfund Citizens Taskforce has been recognized by the US Environmental Protection Agency as one of the most influential and active CAGs in the United States. It has the largest membership of any CAG in the nation and has established open communication with US EPA, Michigan Department of Environmental Quality, and our local, state and federal representatives (many of whom attend meetings regularly). It was the Pine River Superfund Citizens Taskforce that initiated the writing of the NIHS grant. As we move forward on this grant effort, we plan to maintain the CAG as the primary vehicle for assessing community health objectives and responses to research findings.
- The local medical personnel and federal, state, and local administrators may be called-upon to support the community, as results of the research are determined.
- The researcher who designed and will conduct the study, analyze the data and take the lead in their interpretation will be present to answer the questions of the task force.
- The board of experts is composed of external scientists who assess the study results and the study methods.
- Local industry and representatives of local institutions, including churches, unions, civic and fraternal organizations, and environmental groups have been welcomed at Task Force meetings.

Because lay people and researchers have different points of view with regard to the study population (e.g. who should participate in the study) and to the study results (e.g. simple interpretation of results vs. a more complex interpretation), those conflicts of interests should be clarified. As resources are not unlimited, scientists should discuss with community activists whether a study has a real chance of finding an existing association (e.g. dealing with small sample sizes/power calculation). In this discussion, scientists might profit by enlarging their field of vision beyond effects, associations, causalities and plausibility.