

# Metropolitan Mosquito Control District

January 1999

## A PROGRAM EVALUATION REPORT



Photos courtesy of Metropolitan Mosquito Control District

Office of the Legislative Auditor  
State of Minnesota



STATE OF MINNESOTA  
**OFFICE OF THE LEGISLATIVE AUDITOR**  
JAMES R. NOBLES, LEGISLATIVE AUDITOR

January 14, 1999

Members  
Legislative Audit Commission

In April 1998, the Legislative Audit Commission directed us to evaluate the Metropolitan Mosquito Control District. Some legislators had expressed concern about the public oversight and accountability of the District, the effectiveness of its control program, how it notifies the public about its treatment activities, and the effect of the insecticides used by the District on humans and the environment.

We found that the District uses approved and registered insecticides, and generally has applied them according to label instructions. In addition, we found that in 1998, the District applied insecticides only after pretreatment thresholds indicated that treatments were necessary.

However, we identified concerns with the District's 1998 adult treatment policy and management of its treatment data. We also found that language contained in state law on the District's access to property is unclear and contradictory, and we recommend that the Legislature consider changing this language. Finally, we examined several alternatives to the current governance structure of the Metropolitan Mosquito Control Commission. Although we do not recommend a major restructuring, we suggest that the Legislature review the size and composition of the Commission.

We received the full cooperation of the staff of the Metropolitan Mosquito Control District. This report was researched and written by Susan Von Mosch (project manager), Carrie Meyerhoff, and Katherine Seiden. In addition, Dr. Edward (Ted) B. Radcliffe, from the Department of Entomology at the University of Minnesota, volunteered his time to review Chapter 2 of the report.

Sincerely,

Handwritten signature of James Nobles in black ink.

James Nobles  
Legislative Auditor

Handwritten signature of Roger Brooks in black ink.

Roger Brooks  
Deputy Legislative Auditor

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# Metropolitan Mosquito Control District

## SUMMARY

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### **The Metropolitan Mosquito Control District controls mosquitoes and black flies and monitors disease-carrying ticks.**

**T**he Metropolitan Mosquito Control District (MMCD) was created in 1958 as a local joint powers agreement. Legislation passed in 1959 recognized the District in state law (*Minn. Stat.* §§473.701-473.716). The District is responsible for controlling mosquitoes, black flies, and disease-carrying ticks in Anoka, Dakota, Hennepin, Ramsey, Scott, Washington, and the eastern part of Carver counties. MMCD is governed by a 17-member commission composed of county commissioners from participating counties. The Legislature has given the Metropolitan Mosquito Control Commission discretion in how it carries out its mosquito and black fly control responsibilities.

Over the past several years, environmental groups, some legislators, state and federal agencies, and localities have raised questions about the District's operation. Concern has been expressed about the public oversight and accountability of the District, the effectiveness of its control program, how it notifies the public about its treatment activities, and the effect of the insecticides used by the District on humans and the environment.

Because of these concerns, the Legislative Audit Commission directed us in April 1998 to evaluate the Metropolitan Mosquito Control District. In our study, we asked:

- **What does scientific research say about the effects of insecticides used by the Metropolitan Mosquito Control District on humans and other species not targeted for control?**
- **How is the District funded, organized, and staffed?**
- **Is the District effective at reducing larval and adult mosquito populations?**
- **How well does MMCD inform the public of its mosquito control activities?**
- **Are changes needed to make the District more accountable to the Legislature and the public? How are mosquito control services provided in other states?**

To answer these questions, we reviewed previous reports and studies about the Metropolitan Mosquito Control District, state statutes and laws, District policies and procedures, and minutes of Commission meetings. We also reviewed U. S. Environmental Protection Agency (EPA) documents and scientific literature on the insecticides used by MMCD. We analyzed financial audit reports and budget documents. We interviewed Commission members, District staff, members of the Technical Advisory Board and Scientific Peer Review Panel, staff from other public agencies, and representatives of environmental groups. We visited the District's regional offices, observed field operations, and analyzed treatment databases to gain an understanding of MMCD's operations. Finally, we surveyed citizens who had telephoned the District in 1997 and conducted telephone interviews with representatives of state agencies and mosquito control programs in other states.

## SAFETY ASSESSMENT OF INSECTICIDES USED TO CONTROL MOSQUITOES

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**The District uses insecticides that are approved by EPA and registered with the Minnesota Department of Agriculture.**

The Metropolitan Mosquito Control District uses a variety of insecticides to kill mosquito larvae, adult mosquitoes, and black flies. First, it uses a natural soil bacteria (*Bacillus thuringiensis israelensis* or *Bti*) to kill mosquito and black fly larvae. Mosquito breeding sites larger than three acres are treated by helicopter and smaller sites are treated by ground crews. Second, it deploys briquets and pellets containing methoprene, a growth regulator that stops mosquito larvae from hatching into adults. Methoprene briquets are applied by hand to sites that are three acres or less and are hard to reach. Methoprene pellets may be applied by helicopter to larger sites or by ground crews to smaller sites. Third, it uses synthetic insecticides (resmethrin and permethrin) in public parks, recreation areas, and neighborhoods to kill adult mosquitoes. MMCD applies resmethrin using ultra-low-volume foggers mounted on trucks or all-terrain vehicles or hand-held foggers. Permethrin is applied to foliage with power backpack misters.

The District uses insecticides that are approved by the U. S. Environmental Protection Agency and registered with the Minnesota Department of Agriculture for use in insect control.

- **Our conclusion from reviewing the scientific literature is generally consistent with EPA's position that *Bti* and methoprene, the insecticides the District uses to kill mosquito and black fly larvae, pose little risk to people and most nontarget species.**

EPA has found that when *Bacillus thuringiensis*, of which *Bti* is a variety, is applied at label rates the risks to nontarget species are minimal to nonexistent. EPA also found that methoprene is of low toxicity and poses little risk to people and most other nontarget species.

In 1985, MMCD created a 10-member independent research panel to oversee research on the effects of the District's larval insecticides. The Scientific Peer Review Panel (SPRP) was composed of experts in biology and toxicology from several universities in the United States and Canada, as well as state and federal

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**While environmentalists are concerned about adult insecticides, some scientists also remain concerned about the effects of larval insecticides.**

government agencies. Two panel members were selected by environmental groups. In 1987, the SPRP began the Wright County Long-Term Experiment to study the effects of *Bti* and methoprene in Minnesota wetlands.

- **The Scientific Peer Review Panel found that *Bti* and methoprene treatments had no adverse effects on aquatic micro-organisms (zooplankton), the reproduction of red-winged blackbirds, or the numbers of 18 other bird species.**

But research results on the effects of *Bti* and methoprene on midges, a nonbiting fly, were inconclusive. Early research results found that after three years (1991-93) of treatment *Bti* and methoprene had an adverse effect on the numbers of aquatic insects, particularly midges and other primitive flies. However, analysis of samples collected in 1997, after several years of treatment, concluded that few statistically significant differences in the numbers of midges were found between treated and untreated sites for either *Bti* or methoprene. Environmentalists and some scientists remain concerned about the effects of *Bti* and methoprene on other species, especially midges.

Resmethrin and permethrin, the insecticides used by MMCD to kill adult mosquitoes, are more controversial than larval insecticides.

- **Studies by EPA and the World Health Organization found that resmethrin and permethrin are broad-spectrum insecticides with the potential to harm other types of insects and aquatic organisms, but they should not be harmful to humans or the environment if applied according to label instructions.**

Product labels state that permethrin and resmethrin are extremely toxic to fish and other aquatic organisms and may not be applied directly to water. They are also toxic to bees. But experts have concluded that they should not pose hazards to the general public or attain levels of environmental significance when used at the recommended doses and applied in the prescribed manner.

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**Permethrin and piperonyl butoxide, an active ingredient in resmethrin, are classified as possible human carcinogens by EPA.**

In 1993, the Minnesota Department of Health (MDH) assessed the risk to humans of the adult insecticides used by MMCD. The department concluded that “exposure to [resmethrin and permethrin] through ingestion or skin contact does not pose a health risk to humans under the scenarios described . . . . Brief inhalation of the pesticides should not pose a health risk. Nevertheless, children should be prevented from having prolonged inhalation exposure to the pesticides.”<sup>1</sup> MDH advised, for example, that children should not be permitted to follow the insecticide applicators as they work. The risk assessment assumed worst-case scenarios for exposure to the insecticides and included a wide margin of safety for people who might be sensitive to the chemicals.

EPA has classified permethrin and piperonyl butoxide, an active ingredient in resmethrin, as possible human carcinogens. This means that there is limited

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<sup>1</sup> Minnesota Department of Health, “Risk Assessment on Scourge and Punt Materials Used by the Metropolitan Mosquito Control District for the Control of Adult Mosquitoes,” March 17, 1993.



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**The Department of Agriculture said the District has a good record of complying with regulations.**

evidence of a cancer causing link in animals. However, these products must be applied judiciously and in strict conformity with EPA label requirements.

The use of pesticides will alter the ecology of the environment, if nothing else, by killing mosquitoes. Some scientists recognize this and say that MMCD is using the most appropriate chemicals available for mosquito control. Other scientists, conservationists, and environmentalists argue that the use of any insecticides is unacceptable. For example, waterfowl experts are concerned about the killing of mosquitoes because they are part of the food chain in Minnesota wetlands. We are unable to reconcile these competing points of view because they represent different scientific perspectives and value judgments. Ultimately, decisions about whether to continue using insecticides to kill mosquitoes are policy decisions that are best made by the Legislature using the best scientific information available.

We examined MMCD's compliance with pesticide application regulations and found that:

- **To the best of our knowledge, MMCD usually has applied insecticides according to label instructions and in compliance with state regulations.**

We talked with Minnesota Department of Agriculture staff and reviewed their enforcement files. Department of Agriculture staff told us that the District has a good record of complying with pesticide rules and regulations. Records show that between 1979 and 1997, MMCD reported 15 incidents or spills of control materials. The department conducted three routine inspections of MMCD regional offices since 1994 which resulted in several noncompliance notations at one office. Between 1986 and 1997, the department investigated seven citizen complaints against MMCD, two of which resulted in enforcement actions.

## **ORGANIZATION, FINANCING, AND STAFFING**

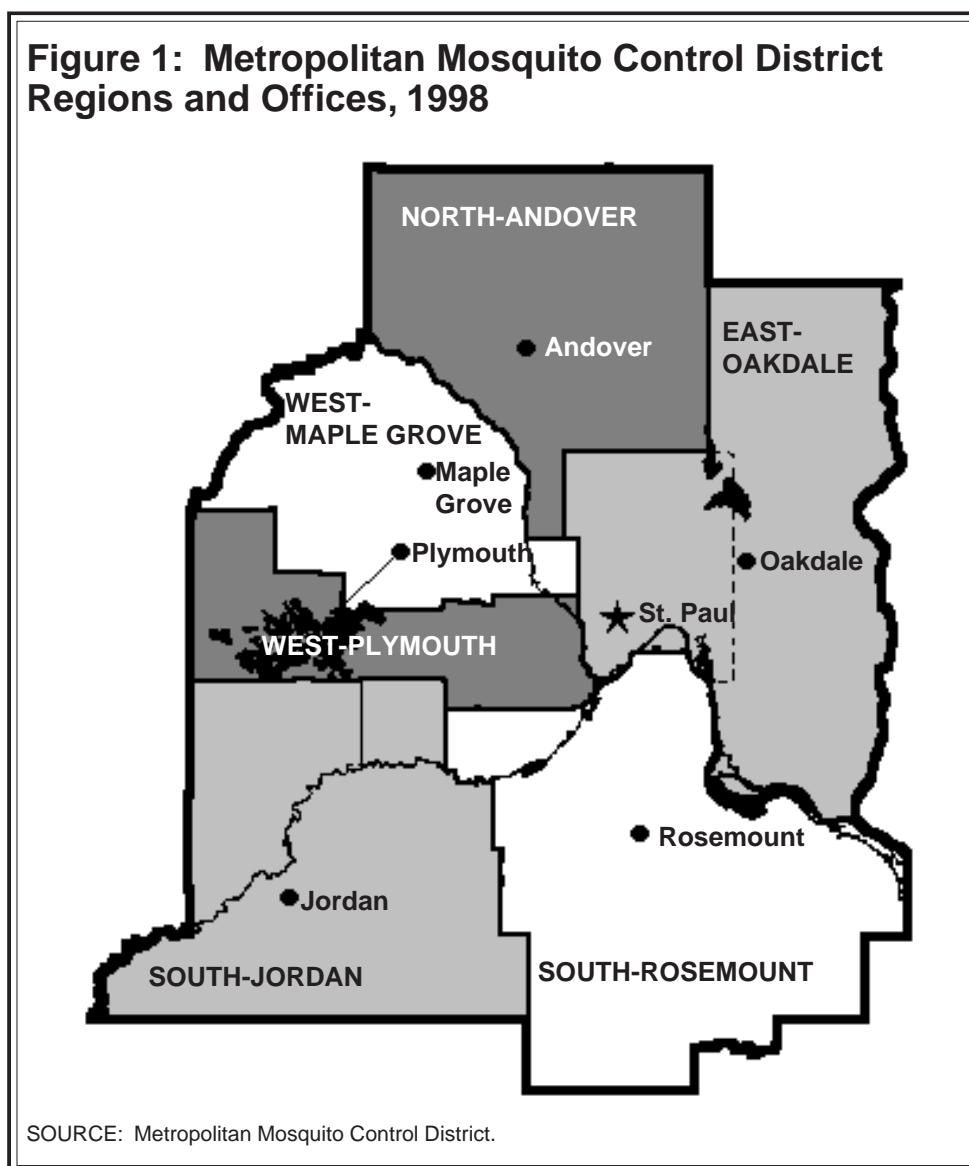
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**The District employed 47 full-time and 164 seasonal staff in 1998.**

The Metropolitan Mosquito Control Commission sets policy for the District and delegates implementation to a professional staff. The Commission appoints a director who is responsible for managing the operations of the District and must be an entomologist. In 1998, MMCD employed 47 full-time staff and 164 seasonal staff, the majority of whom were responsible for providing insect control services. Administrative, communications, and technical services staff are housed in the District's headquarters office in St. Paul, while staff who monitor and control insects work out of six regional offices (see Figure 1).

As a special taxing district, the Commission is authorized to levy property taxes. The District's 1998 budget of approximately \$8.6 million came from a property tax levy (72 percent), Homestead and Agricultural Credit Aid (13 percent), other miscellaneous revenues (4 percent), and a portion of the District's fund balance (10 percent). Mosquito and black fly control activities accounted for 89 percent of the budget in 1998, of which about 44 percent funded salaries and wages.

**Figure 1: Metropolitan Mosquito Control District Regions and Offices, 1998**



**In 1995, the Legislature reduced the District's revenues, but current spending is close to pre-reduction levels.**

In 1995, the Legislature reduced the District's revenues by reducing its property tax levy and state aid payments by 50 percent, resulting in a 22 percent reduction in actual expenditures in 1996. The District responded by laying off staff and reducing mosquito control services. The District's expenditures increased 11 percent between 1996 and 1997 and its approved 1998 budget increased 11 percent. As a result, the District's 1998 budget has approached its spending level of 1995, when its actual expenditures were \$8.8 million.

In the late 1980s and early 1990s, the District maintained a substantial fund balance—over \$15 million in 1989. The District's unreserved fund balance had declined to about \$6.1 million in 1997 and was projected to be about \$5.3 million at the end of 1998.

Concern has been expressed about how the District deals with several issues related to staffing. In the past, some people have criticized the District for using its seasonal positions to provide political favors. Although we were not able to check every case,

- **We found no evidence that MMCD has used seasonal positions to provide political favors.**

Since 1996, responsibility for hiring seasonal staff has been decentralized; group leaders in each regional office interview and select seasonal employees. *Minnesota Statute* §473.704, subd. 5 forbids family members of commissioners from working at MMCD, and financial audit reviews of personnel records in 1996 and 1997 did not find a problem in this area. However, in two instances over the past two summers, children of MMCD staff have worked as seasonal staff. We do not know if any favoritism was involved in their hiring and, in any case, the state law cited above does not apply to District staff. In neither instance was the individual assigned to work in the same office as their parent.

Another criticism of MMCD staffing has been that the District employs too many full-time staff given the seasonal nature of its work. We reviewed the responsibilities of full-time employees and concluded that:

- **It does not appear that the District has been over staffed in its administrative area.**

The District has eight administrative staff and it contracts for services that it does not require on a full-time basis or that require technical expertise.

Staff responsible for insect control activities are divided between technical services staff in St. Paul and field staff housed in six regional offices. The seven technical services staff, including several entomologists, are responsible for collecting and analyzing the insect samples and information essential to the District's operations. Since the 1996 budget cut, the responsibilities of individual technical services staff have been expanded to absorb the responsibilities of terminated staff.

We are not able to say whether MMCD employs too many full-time field staff. Field staff include 5 group leaders responsible for managing 6 regional offices and 27 team leaders—between 4 and 7 in each regional office. One group leader manages both the Maple Grove and Plymouth regional offices. The group leader in the Rosemount office is also the District's specialist on insect-borne disease. The team leaders are represented by Local 132 Construction and General Laborers Union of the AFL-CIO. A 1995 state law prevents the District from terminating employees before January 1, 1999 (except for cause) if they are covered under the terms of a collective bargaining agreement.

## MOSQUITO CONTROL ACTIVITIES

The District's mission is "to promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner." The District's primary focus is on 15 mosquito species that are either aggressive human biters or potential carriers of disease. It has identified over 65,000 mosquito breeding sites covering about 189,000 acres in the Twin Cities area.

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**The District treated 15 percent fewer acres in 1998 than in 1997, reflecting changed weather conditions.**

MMCD claims that the main goal of its mosquito control activities is to kill mosquito larvae, with limited localized adult mosquito control to reduce mosquito annoyance in public parks and at public events and to prevent disease transmission. We examined the District's treatment data to verify whether the District focuses on killing mosquito larvae. Table 1 shows that the District treated almost 197,500 acres with insecticides in 1998, a 15 percent reduction from 1997. The data also show that:

- **Except for 1996, MMCD has treated more acres to kill mosquito larvae than to kill adult mosquitoes.**

The District's treatment of mosquito larval breeding acres represented 68 percent of all acres treated in 1995 and 64 percent of all acres treated in 1998. In 1996, however, the District treated nearly 46 percent fewer mosquito larval breeding acres and 85 percent more acres to control adult mosquitoes than it did in 1995. This change was partly the District's reaction to its reduced 1996 budget and partly related to 1996 being a drier than normal summer. Each year since 1996 the District has increased the number of larval breeding acres treated and reduced the number of acres treated to kill adult mosquitoes. MMCD treated about 37 percent fewer acres for adult mosquitoes in 1998 than in 1997. According to the District, drier weather conditions determined the number of acres treated, not any purposeful intent on the District's part to reduce the acres treated for adult control.

MMCD has a policy of only applying insecticides when pretreatment counts of mosquito larvae or adults meet or exceed certain established thresholds. We examined MMCD 1998 treatment data to determine whether the District has followed its own policy for deciding when to apply insecticides and found that:

- **In nearly all cases in 1998, the District treated mosquito breeding sites by helicopter and sprayed for adult mosquitoes only after pretreatment thresholds had been met.**

Of 5,083 breeding site treatments in 1998, 95 percent met the District's predetermined treatment threshold. Of 3,763 adult mosquito treatments in 1998, the District met the established threshold in 99 percent of the treatments. Consequently, we concluded that:

- **In 1998, MMCD followed its treatment thresholds for mosquito larvae and adults. However, it appears that MMCD has not followed its 1998 adult treatment policy.**

**In 1998, almost 2/3 of all acres treated with insecticides were treated in order to control mosquito larvae.**

**Table 1: Acres Treated by MMCD with Larval and Adult Insecticides, 1995-98**

<u>Mosquito Larvae Control</u>	<u>1995<sup>a</sup></u>	<u>1996<sup>a</sup></u>	<u>1997<sup>b</sup></u>	<u>1998<sup>c</sup></u>
Methoprene briquets (150-day timed-release)	7,303	421	501	371
Methoprene briquets (90-day timed-release)	0	0	0	961
Methoprene pellets	8,212	10,654	8,851	10,432
Methoprene liquid	668	565	1,645	425
<i>Bti</i> granules	<u>131,589</u>	<u>68,355</u>	<u>106,755</u>	<u>113,538</u>
Total	147,772	79,996	117,752	125,727
<u>Mosquito Adult Control</u>				
Permethrin	6,305	5,914	7,035	6,175
Resmethrin	<u>61,858</u>	<u>120,472</u>	<u>106,441</u>	<u>65,586</u>
Total	68,163	126,387	113,476	71,761
Grand Total	215,935	206,383	231,228	197,488
<u>Black Fly Control</u>				
<i>Bti</i> liquid (in gallons)	3,606	3,025	5,445	4,032

NOTES: Treatments with Laginex liquid and sand-based materials used in Wright County research and in regional offices on an experimental basis are not reflected. Numbers may not sum due to rounding.

<sup>a</sup>The 1995 and 1996 acres are based on Metropolitan Mosquito Control District computer treatment records.

<sup>b</sup>The 1997 acres are estimated using the Metropolitan Mosquito Control District's audited inventory records. Estimates are based on assumptions regarding the use of materials at different application rates.

<sup>c</sup>The 1998 acres are based on Metropolitan Mosquito Control District computer treatment records through mid-September. The figure for *Bti* liquid (in gallons) used for 1998 is from the District's inventory records for 1998 through September 12, 1998.

SOURCES: Metropolitan Mosquito Control District treatment data for 1995, 1996, and 1998; Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, Consumable Inventory Work Papers Folder 5.

**The District needs to review its policy for providing adult mosquito treatments to for-profit enterprises.**

The District's adult treatment policy emphasizes that it provides localized adult mosquito control for public parks and recreation areas, public events, potential disease situations, and in response to citizen requests, but public events operated for profit will not be treated. We found examples of the District providing adult treatments for private functions and for-profit enterprises. District staff told us that they provide adult mosquito treatments to for-profit enterprises based on a 1996 discussion with the executive committee of the Commission. However, provisions for treating for-profits were not incorporated into the District's adult mosquito treatment policy when it was revised in June 1998. It was not clear to us



whether MMCD does not treat for-profits, treats them for a fee, or treats them at no charge. We recommend that:

- **The Metropolitan Mosquito Control Commission should review the District’s existing policies and procedures and adopt a comprehensive, well articulated adult mosquito treatment policy.**

Further, MMCD should reexamine its adult treatment procedures to ensure that its practices conform with its adult treatment policy.

In 1998, the main reasons for adult mosquito treatments were customer requests and treatment of parks and events. However, about 17 percent of the acres treated (up to 39 percent in some regions) were classified as “other” or were missing a reason for treatment. Though flawed, the adult treatment data suggested that treatments done to prevent transmission of diseases have been a small proportion (fewer than 3 percent) of the District’s adult treatment activities.

Our review of MMCD treatment and inventory records found that:

- ***Bti* accounted for 9 out of 10 acres treated to kill mosquito larvae, while resmethrin accounted for 9 out of 10 acres treated to kill adult mosquitoes between 1995 and 1998.**

Our analysis also showed that these insecticides were the least costly to use per acre. *Bti* granules cost between \$4.82 and \$8.47 per acre, compared with over \$52 per acre for methoprene pellets and over \$388 per acre for methoprene briquets in 1997. Similarly, resmethrin cost between \$1.00 and \$1.66 per acre, compared with over \$7.60 per acre for permethrin in 1997. We were unable to estimate what proportion of the District’s total budget was dedicated to larval versus adult control activities. However, larval insecticides accounted for over 91 percent of total insecticide costs in 1997.

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**The predominant insecticides used by the District, *Bti* and methoprene, were also the least costly per acre treated in 1997.**

## Refused Treatment Requests

Since 1982, state law has given private property owners the right to restrict access to MMCD “except for control of disease bearing mosquito encephalitis outbreaks.” MMCD provides a 100- to 600-foot buffer zone in all directions around each “no treatment” property depending on the type of insecticide used and the method of application.

While MMCD records refused treatment properties on maps and paper card files, the District has not maintained a computerized database of these properties since 1995. In 1995, about half of the approximately 57,000 acres of refused treatment property actually contained mosquito breeding areas, representing about 14 percent of all mosquito breeding acres in the region. Currently, MMCD allows both private property owners and public property managers, including the Commissioner of Natural Resources, to refuse treatment for larval and/or adult mosquito control operations, even though the state law specifically allows the District to enter Department of Natural Resources (DNR) property for mosquito control purposes.

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**Language in state law on the District's access to public property is unclear and contradictory.**

We concluded that language in state law related to MMCD's access to public property is unclear and contradictory. *Minnesota Statute* §473.704, subd. 17 says the District may enter any property "subject to the paramount control of the county and state authorities." A 1982 amendment to this subdivision requires the Commissioner of Natural Resources to allow the District to enter DNR property for mosquito control purposes, but the original "paramount control" language remains.<sup>2</sup> In other words, state law allows counties and state authorities the right to determine what mosquito control activities occur on their land, but then goes on to remove that right from the DNR. We suggest that:

- **The Legislature should consider whether state law should allow the Department of Natural Resources and local units of government the right to refuse access to MMCD, except for monitoring and treatment of mosquitoes that can carry diseases.**

Over 40 percent of the refused treatment acres in 1995 were requests from federal or state agencies, or local governments, including the Minnesota Department of Natural Resources. Staff from these entities cited issues related to compatibility with conservation and ecological goals and concerns about insecticides as reasons for refusing treatment. We think that there are some situations when DNR and local units of government should be allowed to determine whether mosquito control activities are conducted on public property. Specifically, we believe that entities managing public land for ecological and natural resource reasons should have the right to refuse mosquito control treatments. Agencies, such as MMCD, that want an exception from the paramount control of these public land managers should have to prove to the Legislature why such an exception is warranted. The Legislature may also want to consider extending the ability to refuse access to MMCD to cities and townships, giving these entities the same rights that are currently available to county and state authorities and to private landowners.

We also recommend that:

- **The Metropolitan Mosquito Control Commission should develop a refused treatment policy that addresses both larval and adult mosquito control operations.**

Currently, the only policy statement related to refused treatment is included in the District's adult mosquito treatment policy. The District does not have a written policy for refusing larval control treatments, although the right to refuse treatment applies to larval insecticides. We believe a comprehensive refused entry policy would be beneficial for the District, private landowners, public agencies, and units of government in the Twin Cities area.

In the past the District has maintained a refused treatment request indefinitely. According to MMCD staff, the District is considering requiring an annual renewal of refused treatment requests. Given the sensitive nature of this issue, we believe

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<sup>2</sup> In contrast, state laws relating to local mosquito abatement boards (*Minn. Stat.* §§18.041-18.161) provide that local mosquito abatement plans are subject to DNR approval, modification, and revocation. (*Minn. Stat.* §18.121, subd. 2.)

that an annual renewal requirement belongs in a refused treatment policy that has been reviewed and approved by the Commission.

State law and MMCD's current buffer zones create the potential for conflict between persons who do not want treatment and neighbors who do. To balance these interests, MMCD could reduce the size of its buffer zones or adopt other methods of addressing refused treatment situations. Aside from these approaches, balancing these interests becomes a policy issue that the Legislature may want to address.

## Insect-Borne Disease Prevention

In addition to controlling mosquitoes that cause annoyance, MMCD monitors and controls for mosquitoes that can carry diseases. The tree hole mosquito, which breeds in tree holes and artificial containers such as waste tires and can transmit LaCrosse encephalitis, is the primary focus of District disease prevention activities. District staff identify and remove breeding sites, evaluate areas around previous cases of LaCrosse encephalitis, provide public education, and conduct limited adult spraying.

- **Epidemiology staff at the Minnesota Department of Health told us that the District has played a valuable role in preventing the transmission of mosquito-borne diseases and monitoring deer ticks.**

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**The District works closely with the Department of Health to monitor and control insect-borne diseases.**

The District works closely with the Department of Health (MDH), the state's public health agency responsible for disease surveillance and prevention, in the area of insect-borne disease management. The District depends on MDH for information on cases of LaCrosse encephalitis. In turn, MDH relies on the District for mosquito surveillance and control measures to reduce disease transmission. MDH has also relied on MMCD to provide education and technical assistance to counties in southeastern Minnesota.

## Data Management Issues

The District uses treatment records to summarize its mosquito control activities and inform its Commission, county boards, legislators, and the public about its activities. The District contracted with an outside firm for data entry services until 1997, when it brought the function in house. We found that there were too many errors in the District's computerized treatment records for 1997 to be used to reliably describe mosquito control activities. We recommend that:

- **The District should establish rigorous quality control standards for its treatment data if it intends to use these data to accurately assess its activities, conduct future planning, and inform the public about its activities.**

District staff established procedures during the summer of 1998 to periodically compare and reconcile insecticide inventory records with treatment data. This process aided in the identification and correction of problems with the 1998 treatment data.

In addition to problems with data management, we found a number of seemingly isolated problems with MMCD's operations. Examples include the untimely filing of insecticide applicator licensing papers and fees with the Department of Agriculture in 1997, mistaken application of insecticides in both 1997 and 1998 at a scientific and natural area that the Department of Natural Resources had asked not to be treated, and failure to maintain useable data files for refused treatment properties. Taken together, these problems suggest a lack of attention to detail and vigilance on the part of District staff. It is the responsibility of District management to place greater emphasis on quality controls necessary to identify, correct, and avoid these problems in the future.

## EFFECTIVENESS OF MOSQUITO CONTROL

The goals of MMCD's insect control efforts are to reduce the regional populations of mosquitoes. However, entomologists told us that it is difficult to measure the reduction in adult mosquito populations resulting from larval control activities. In 1996, after considering factors such as weather, mosquito breeding habitat, people's behavior and perceptions, and costs, an Interagency Panel on MMCD Effectiveness concluded that predicting what "would have been" without intervention would be difficult. We found that:

- **The results of District-sponsored studies on the overall effectiveness of mosquito control efforts have been inconclusive.**

Comparisons of adult mosquito populations have shown lower mosquito populations outside the District or before the District was created. Therefore, the District has tested the effectiveness of larval insecticides and used the results of those material efficacy tests to measure the effectiveness of its mosquito control efforts. The District attempts to achieve 95 percent mortality of mosquito larvae and adults when it uses insecticides. This goal is based on EPA guidelines. We found that:

- **Most of the insecticides used by the District to kill mosquito larvae have not met the goal of 95 percent mortality.**

The average control achieved with *Bti* granules, the larval insecticide that accounted for most of the breeding acres treated, ranged from 78 to 89 percent in 1995-97. On the other hand, methoprene briquets and pellets used to kill cattail mosquito larvae have performed the best (92 to 99 percent mortality). It could be argued that, while the goal of 95 percent mortality might be ideal, the rates of control achieved for the above products are reasonable. However,

- **We have some concerns about how MMCD has calculated and presented information on the effectiveness of methoprene products used to control floodwater mosquitoes.**

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**The effectiveness of most insecticides used by the District has been reasonable.**

First, we were not able to replicate MMCD’s control figures for 1996 and 1995 using the District’s own data. According to District staff, a former staff person had completed these analyses and current staff were unable to locate the information on how those calculations were made. Second, the calculations for 1997 contained typographical errors that changed negative rates to positive rates, indicating a positive effect when none was shown. While these errors did not change the results in this instance, they raise concerns about methods and quality controls used to calculate material efficacy. Third, in 1996 and 1997, the District’s evaluation of mosquito control achieved with methoprene briquets was based on a sample of only five sites. Finally, annual fluctuations in the effectiveness of methoprene briquets and pellets are evident in Table 2. The District has updated information on the effectiveness of methoprene reported in its *1997 Operational Review and Plans for 1998*. Instead of achieving 77 percent control based on 69 sample sites as reported, the District achieved 73 percent based on 39 sample sites. Because effectiveness rates may affect District decisions about insecticide use, we recommend that:

- **The Metropolitan Mosquito Control District should critically examine how it measures the effectiveness of methoprene products to control floodwater mosquito larvae and reevaluate its use of these products considering both efficacy and cost factors.**

**The effectiveness of methoprene products used to kill floodwater mosquitoes has been inconsistent.**

**Table 2: Average Percent Control with Methoprene for Floodwater Mosquitoes Reported by the Metropolitan Mosquito Control District, 1995-97**

<u>Percent Control Reported</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1997 MMCD Corrected</u>
Briquets	82% (N=106)	55% (N=5)	81% (N=5)	NA NA
Pellets	88% (N=63)	80% (N=66)	77% (N=69)	73% (N=39)

NOTE: NA = Additional data were not available.

SOURCES: Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*; Electronic-mail message from Mark Smith, Technician, October 26, 1998.

In its 1996 operational review, the District noted that: “Performance of methoprene products must improve if MMCD is to achieve the target rate of at least 95 percent control in treated mosquito breeding sites.”<sup>3</sup> The District’s 1997 operational review did not express any concerns about the effectiveness of methoprene products and its use of methoprene products has not changed. In 1998, the District increased the number of sites sampled to test effectiveness of

<sup>3</sup> Metropolitan Mosquito Control District, *1996 Operational Review and Plans for 1997*, March 1997: 35.



methoprene pellets, but only five sites could be analyzed for briquets. In its 1999 budget, the District suggests that it will increase the number of sites examined to document material efficacy.

We also reviewed the District's research on the effectiveness of resmethrin and permethrin. During the early 1990s, the District sponsored several studies on resmethrin and permethrin. While permethrin appears to kill mosquitoes for up to five days, the District's own research appears to question the effectiveness of resmethrin at controlling mosquitoes one day after treatment. We found that:

- **In 1996, the District tested the effectiveness of resmethrin and permethrin, the insecticides used to kill adult mosquitoes, and estimated that the average adult mosquito reduction in treated sites was about 57 percent.**

The District collected pre- and post-treatment adult mosquito counts in 1998 to evaluate the effectiveness of the adult insecticides. Comparison of these counts showed a 90 percent reduction in the number of adult mosquitoes following treatment. We have some concerns about using this data to measure effectiveness, such as the data were not collected as part of a designed, supervised research effort and counts were taken using the "slap test" sampling method, a less standardized, more subjective method than others available. We recommend that:

- **The District should assign a high priority to measuring the effectiveness of adult control materials in scientifically designed and supervised field studies in 1999 and use the results of these studies to evaluate the role of adult mosquito treatments in its overall mosquito control program.**

## **PUBLIC ACCOUNTABILITY AND GOVERNANCE**

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**Public notification of adult insecticide applications is a concern of some legislators, state agencies, and environmentalists.**

Much of the recent criticism of MMCD has focused on the issue of notifying the public when insecticides are applied to kill adult mosquitoes. Staff from the Department of Health have emphasized that MMCD has a responsibility to inform people about when and where insecticides are being applied so that people can choose to avoid exposure. In the past, the District's Technical Advisory Board has also recommended that MMCD increase its efforts to notify people of adult mosquito treatments.

In the past, MMCD has used a telephone information line and a web site to inform people about scheduled adult mosquito treatments. MMCD has also called people who want individual notification of treatments (typically adult or helicopter applications) in their area. The District has issued press releases during the summer and posted areas treated on public land during the treatment.

Currently, Minnesota statutes do not contain language related to public notification for mosquito control programs. During the 1997 legislative session a public notification bill was introduced, but did not pass. Afterwards, the District

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**The District maintains a telephone information line and a web site to inform people about adult mosquito treatments.**

and the authors of the proposed legislation reached a “negotiated agreement,” under which MMCD placed an advertisement in newspapers notifying the public of possible adult mosquito insecticide applications and posted notices at the main entrances of public land, leaving the signs in place for five days. Although the agreement lacks the force of law, we recommend that:

- **MMCD should continue the level of public notification provided during the summer of 1998.**

We think the District should continue to publish an annual advertisement in newspapers in the spring of each year, containing information on the nature of mosquito control treatments and accurate, objective information on the insecticides used. Our review of other states showed that this is a commonly used method of public notification. We also think the District should continue posting notices of adult mosquito treatments at the entrances of public parks and recreation areas. This will provide people with information allowing them to avoid exposure to insecticides if they so choose. If the Legislature finds in the future that the District has not provided these notifications, then it should consider adding public notification requirements to state law.

## Relationship with the Public

In its 1998 survey of Twin Cities residents, MMCD found that 61 percent of the people surveyed were aware of the District, similar to results of prior surveys. We surveyed a random sample of citizens who called MMCD to request or refuse service or get information in 1997 and concluded that:

- **There is a high level of satisfaction among people who had requested service from the Metropolitan Mosquito Control District in 1997.**

Nearly 80 percent of the people we surveyed said they were “satisfied” or “very satisfied” with the District’s response to their request.

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**The District should be careful to present the most accurate information possible to the public.**

Despite high satisfaction ratings from some segments of the population, the Metropolitan Mosquito Control District has found itself in an adversarial position in recent years as environmentalists question the District’s operations. During the summer of 1998 there was an intense public relations debate between the District and environmental groups, and we became aware of a certain level of mistrust among the parties involved. In this type of atmosphere, we believe it is crucial for the District to exercise the utmost care in presenting the most accurate information possible to the public. Unfortunately, the District might have contributed to feelings of mistrust by making claims that are hard to support, such as the assertion that requests for no treatment impair its ability to protect public health and prevent LaCrosse encephalitis. While we have noted that MMCD provides valuable disease prevention services, we have also observed that most of the District’s adult mosquito treatments are directed at nuisance mosquitoes. In addition, state law gives the District authority to take necessary mosquito control measures in situations of disease outbreak, regardless of refused treatment requests. We think MMCD should make more of an effort to present balanced, accurate information to the public.

## Governance

As far as we can determine,

- **The Metropolitan Mosquito Control Commission generally has complied with state laws designed to provide public accountability.**

Based on our analysis, the Commission and the District have complied with relevant enabling legislation, the state’s Open Meeting and Ethics in Government acts, and purchasing, tax levy, budgeting and accounting, and audit controls contained in state law. The District has been subject to annual financial audit reviews by the Office of the Legislative Auditor that have not found problems with its financial controls. However, we found that the Commission did not submit a required financial report to the Legislature in 1996 and it has not always classified as “public” information on citizens who request or refuse service as required by state law. We recommend that:

- **In the future, the Commission should submit biennial financial reports to the Legislature and classify as “public” information on citizens who request or refuse service.**

MMCD is governed by a 17-member commission composed of county commissioners appointed annually by their respective county boards. An executive committee, made up of three officers, plus one member from each county not represented by an officer, meets monthly. The full commission meets about six times a year to review agenda items, “ratify” decisions of the executive committee, and approve policy for the District.

A Technical Advisory Board (TAB) reviews the goals, plans, operations, and research of the District and reports to the Commission. The TAB, composed of professionals representing state agencies, the University of Minnesota, and industry and environmental groups, enables the District to obtain advice from public agencies, as required by state law.

After reviewing how mosquito control services are provided in other states, it is clear that there is no ideal structure for providing these services. In most states, local units of government (cities and/or counties) provide mosquito control services with varying degrees of state involvement. Only 4 of the 28 states we contacted have state-operated mosquito control programs—Delaware, Connecticut, Kentucky, and Maryland. Maryland, with a budget of \$1.9 million and 21 permanent staff, has the largest state-operated program. Six other states provide limited funding and technical assistance to locally operated mosquito control programs. In other states, including Minnesota, state law provides for the creation and funding (such as the ability to levy property taxes) of locally operated mosquito control districts. Finally, some states play a limited role related to public health monitoring of insect-borne diseases.

We also examined several alternative governance structures the Legislature could consider to increase oversight of the District. These options include placing the District under the jurisdiction of the Metropolitan Council, placing it in a state agency (such as the Department of Health or the Department of Agriculture), or

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**The District is currently governed by a 17-member commission, but the size and composition of the Commission should be reviewed.**

returning it to a local joint powers board. Lacking compelling reasons for a major restructuring, we do not recommend major changes in the governance structure of the Metropolitan Mosquito Control District at this time. However, we suggest that:

- **The Legislature should consider reducing the size and changing the composition of the Metropolitan Mosquito Control Commission.**

By adding other public representation to the Commission, the Legislature would open the Commission to outside perspectives, help the District respond to outside criticisms, and increase public oversight of the District. Three or four public members could be appointed by the Governor. These members could be selected to represent public park managers, the scientific community, environmental groups, or other expertise. Alternatively, the Legislature could add state agency representatives (such as the commissioner or the commissioner's designee from the department of Health or Agriculture) to the Commission, along with representatives from the scientific and environmental communities. To prevent the Commission from becoming too large, the number of county commissioners serving on the board could be reduced perhaps to seven members, one from each county participating in the District.

We also recommend that:

- **The Metropolitan Mosquito Control Commission and director should evaluate and formalize in a written policy statement the composition, structure, roles and responsibilities, and appointment process of the Technical Advisory Board.**

The TAB membership, role, and responsibilities have never been formalized, and some Metropolitan Mosquito Control Commissioners and TAB members appeared to be unclear about its role. Also, the process used to determine membership on and appointment to the TAB was unclear to some agencies. The Commission may want to evaluate the composition of the advisory board and consider what technical skills and areas of expertise need to be represented on the TAB.

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# Introduction

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## The Metropolitan Mosquito Control District was created in 1958 as a local joint powers agreement.

The Metropolitan Mosquito Control District (MMCD) is responsible for monitoring and controlling mosquitoes and black flies, and for monitoring disease-vectoring ticks in Anoka, Dakota, Hennepin, Ramsey, Scott, Washington, and portions of Carver counties.<sup>1</sup> Originally created as a local joint powers agreement, in 1959 the Legislature recognized the District in Minnesota law. The District is governed by a 17-member commission drawn from the boards of commissioners of the seven participating counties. The Metropolitan Mosquito Control Commission has authority to levy property taxes to support the District's operations. The District's 1998 budget of about \$8.6 million was financed with a property tax levy (72 percent of revenues), Homestead and Agricultural Credit Aid (13 percent), other miscellaneous revenues (4 percent), and a portion of the District's fund balance (10 percent).

MMCD uses a variety of materials and techniques to control mosquito larvae, adult mosquitoes, and black flies. The District uses a bacteria (*Bacillus thuringiensis israelensis* or *Bti*) to kill mosquito and black fly larvae, and also uses a growth regulator (methoprene) to kill mosquito larvae. The District sprays insecticides (resmethrin and permethrin) in local parks and neighborhoods to kill adult mosquitoes.

Although the District serves the Twin Cities area, it is technically not a metropolitan agency and does not have a formal relationship with the Metropolitan Council. Given its unique position between local and regional units of government, some legislators and citizens have expressed concern about public oversight and accountability of the District. Concerns have also been raised about how the District notifies the public about its operations and how it responds to citizens who refuse treatment. Questions have been raised about the effectiveness of the District's operations and the impact of the insecticides used by the District on humans and the environment.

In April 1998, the Legislative Audit Commission asked our office to conduct an evaluation of the Metropolitan Mosquito Control District. In our research, we asked:

- **What state laws govern the Metropolitan Mosquito Control District's operation? How is the District funded, organized, and staffed? How**

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<sup>1</sup> Minn. Stat. §§473.701-473.716.



**are mosquito control services provided in other parts of Minnesota and in other states?**

- **What does scientific research say about the effects of insecticides used by the District on humans and other species not targeted for control?**
- **How does the District operate its mosquito control, black fly control, and deer tick monitoring programs? Can citizens and property owners request adult mosquito treatments or avoid exposure to mosquito control products if they choose?**
- **Is the District effective at reducing larval and adult mosquito populations?**
- **Are changes needed to make the District more accountable to the Legislature and the public? How well does MMCD inform the public of its mosquito control activities?**

To address these questions, we reviewed previous reports and studies about the Metropolitan Mosquito Control District, state statutes and laws, and minutes of the Metropolitan Mosquito Control Commission's meetings. We also analyzed financial audit reports and District budget documents. We attended Commission meetings and interviewed Commission members, District staff, members of the Scientific Peer Review Panel and the Technical Advisory Board, staff from other public agencies, and representatives of environmental groups. We also surveyed citizens who had telephoned MMCD in 1997.

We reviewed MMCD's policies and procedures, made site visits, observed field operations, and analyzed treatment databases to gain an understanding of MMCD's operations. To determine how mosquito control services are provided in other jurisdictions, we examined municipal pest control data filed by Minnesota cities with the Department of Agriculture and conducted telephone interviews with representatives of state agencies and mosquito control districts in other states.

We reviewed documents from the U. S. Environmental Protection Agency (EPA), articles from scientific journals, and research reports to summarize the safety of insecticides used by the District. We also spoke with entomologists in state agencies and at the University of Minnesota.

MMCD evaluates the efficacy of the insecticides it uses for mosquito control. We reviewed results of the District's efforts to measure its effectiveness.

Chapter 1 reviews the statutory framework under which the Metropolitan Mosquito Control District operates, examines the District's organization and structure, and presents other background information about the District and its operations. Chapter 2 summarizes current scientific literature on the insecticides used by MMCD. Chapter 3 examines the District's control activities, including the number of acres treated with insecticides and procedures used to determine if treatments are needed. Chapter 4 presents information on the effectiveness of the District's mosquito control activities. Chapter 5 explores issues of public accountability and the District's relationship with the public.

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# Background

## CHAPTER 1

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**M**osquitoes have been a part of Minnesota history since the first Agricultural Experiment Station entomologist, Otto Lugger, began collecting and describing the state's insects in 1888. Minnesota's natural environment of wetlands and ponds, along with plentiful rainfall, provides ample mosquito breeding habitat. A diary of an early Minnesota surveyor stated: "Life (in this township) is almost unendurable, from the torture of insects, and physical discomforts. I have been stung by mosquitoes . . . while standing in snow knee deep."<sup>1</sup>

In this chapter we review the statutory framework under which the Metropolitan Mosquito Control District (MMCD) operates, examine the District's organization and structure, present information on mosquito and black fly biology, and describe what insecticides and methods are used by MMCD to control mosquitoes and black flies. We address these questions:

- **What are the purposes and mission of the Metropolitan Mosquito Control District? How is the District organized, funded, and staffed?**
- **How have the District's revenues and expenditures, and staffing changed since 1995?**
- **How are mosquito control services provided in other parts of Minnesota?**

To answer these questions, we reviewed previous reports and studies about the Metropolitan Mosquito Control District, state statutes and laws, and minutes of Metropolitan Mosquito Control Commission meetings. We also analyzed financial audit reports and District budget documents and interviewed District staff and commissioners.

The Metropolitan Mosquito Control District was created in 1958. Its enabling legislation (*Minn. Stat.* §§473.701-473.716) states that the District "is created to control mosquitoes." The District is also responsible for controlling black flies and monitoring disease-carrying ticks. The enabling legislation gives the Metropolitan Mosquito Control Commission, the District's governing body, discretion in how the District controls mosquitoes.

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<sup>1</sup> Roger Moon, "A Brief Overview of the Life History, Physiology, and Ecology of Minnesota Mosquitoes," *Journal of the Minnesota Academy of Science* 50:3, 1985: 6.

Mosquito control is the District's principal activity and its primary focus is on 15 mosquito species that are either aggressive human biters or potential carriers of disease. This chapter presents information on the biology of mosquitoes and black flies and it presents information on the methods and insecticides that the District uses to kill them.

## HISTORY

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**In 1959, the Legislature recognized the Metropolitan Mosquito Control District in state law.**

The Metropolitan Mosquito Control District was created in 1958 as a joint powers agreement with six metropolitan counties: Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington. Legislation passed in 1959 recognized the District in state law.<sup>2</sup> Originally, the District was created to control mosquitoes. Over the years, the Legislature also gave MMCD authority to control black flies (1983) and disease-carrying ticks (1989).<sup>3</sup>

The District's geographic area remained the same from 1958 to 1982 when the Legislature added the eastern half of Carver County to the District. At the same time, legislation repealed a provision allowing a county to terminate its participation in the District with a 12-month notice.<sup>4</sup> Instead, a county must obtain legislative approval before it may terminate its participation in the District.<sup>5</sup> A contiguous county may participate in the District if its county board petitions to be admitted and the Metropolitan Mosquito Control Commission agrees.<sup>6</sup> No neighboring county has exercised this option.

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**The District controls mosquitoes and black flies and monitors disease-carrying ticks.**

The Metropolitan Mosquito Control District is governed by a 17-member commission composed of county commissioners from participating counties. Commissioners are appointed by their respective county boards and serve one year terms beginning January 1 of each year. There are no term limits. The current commission consists of three representatives each from Anoka, Dakota, Hennepin, and Ramsey counties; two each from Scott and Washington counties; and one from Carver County.<sup>7</sup>

Legislation gives the Metropolitan Mosquito Control Commission discretion in how it carries out control programs in the district. Specifically, legislation authorizes the Commission to:

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<sup>2</sup> Codified in *Minn. Stat.* §§473.701-473.716.

<sup>3</sup> *Minn. Laws* (1983), ch. 129, secs. 1, 4; and *Minn. Laws* (1989) ch. 146, sec. 1.

<sup>4</sup> *Minn. Laws* (1982), ch. 579, secs. 4, 9.

<sup>5</sup> State law contains specific procedures for appraisal of property and amounts to be paid to a terminated county. It also contains provisions for disposing of property, assets, and liabilities "if the district is dissolved." *Minn. Stat.* §473.712.

<sup>6</sup> *Minn. Stat.* §473.715.

<sup>7</sup> *Minn. Stat.* §473.703. Initially, the Commission had two representatives from each county. The Commission's current composition is related to the size of the county board. In 1982, the counties with seven-member boards were given an additional member. Carver County has one representative because only part of the county is in the District.

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**State law gives the Metropolitan Mosquito Control Commission discretion in how it carries out its responsibilities.**

- undertake control programs in accordance with expert and technical plans;
- employ and fix the duties and compensation of a director and a business administrator;
- employ other persons and contract for services;
- purchase materials, supplies, and equipment; sell and dispose of surplus property; and accept gifts of property;
- prepare and adopt an annual budget, levy taxes, and prepare and submit required financial reports;
- enter into agreements with local jurisdictions outside the district to conduct mosquito control activities in those jurisdictions in order to control mosquitoes within the district; and
- take whatever other acts “are reasonable and necessary to carry out the general and specific powers of the commission.”<sup>8</sup>

State law also gives the Commission and its employees the authority to:

- enter any property within or outside the district at reasonable times to determine the need for control programs;
- take all necessary and proper steps for the control programs on property within the district; and
- enter property and clean up any stagnant pools of water, the shores of lakes and streams, and other breeding places for mosquitoes within the district, subject to the paramount control of county and state authorities.<sup>9</sup>

The Commission may apply insecticides to mosquito breeding sites found inside or outside the district. Prior to applying insecticides *outside* the district, the Commission is required to give reasonable notice to the governing body of the local unit of government.<sup>10</sup>

A 1982 amendment limited the Commission’s access to property by giving *private* landowners the right to refuse the District access to their property “except for control of disease bearing mosquito encephalitis outbreaks.” This amendment also required the Commissioner of Natural Resources to allow the District to enter state property for mosquito control purposes.<sup>11</sup>

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<sup>8</sup> *Minn. Stat.* §473.704, subs. 2-9, 15-16, 19; *Minn. Stat.* §473.711, subd. 2.

<sup>9</sup> *Minn. Stat.* §473.704, subd. 17.

<sup>10</sup> *Ibid.*

<sup>11</sup> *Minn. Laws* (1982), ch. 579, subd. 6.

Finally, state law requires the Commission to cooperate with certain public agencies for the purposes of research and protection of the public health and welfare. In addition, the commissioners of the departments of Agriculture, Natural Resources, Transportation, and Health, and the head of the Department of Entomology at the University of Minnesota are required to act in an “advisory capacity” to the Commission and its director.<sup>12</sup>

## Other Mosquito-Related Provisions in State Law

In addition to the Metropolitan Mosquito Control District’s enabling legislation, mosquito control in Minnesota is governed by two statutes: Local Pest Control, *Minn. Stat.* §§18.021-18.022; and Mosquito Abatement, *Minn. Stat.* §§18.041-18.161.<sup>13</sup>

The Local Pest Control statutes govern mosquito control activities in Minnesota outside of the Twin Cities area. These statutes were originally enacted in 1935 following an extensive grasshopper control effort. They authorize local units of government to establish and fund programs to “control pests that may be detrimental to the health and welfare of humans or animals and to the environment.”<sup>14</sup> Communities are required to submit an annual pest control application to the Department of Agriculture if they intend to engage in any pest control activities.

The Mosquito Abatement statutes provide for governmental units in the state to enter into mosquito abatement districts for “the abatement or suppression of mosquitoes of any kind, whether disease bearing or merely pestiferous.”<sup>15</sup> No governmental unit has elected to establish such a district. Based on a review of these statutes, we think that the Legislature has intended mosquito control to be both a public service and a public health issue.

## Other History

The Metropolitan Mosquito Control District’s operations have been under public scrutiny since the 1970s.<sup>16</sup> The District completed an Environmental Impact Statement (EIS) on the environmental effects of its control programs and use of

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**State law governs mosquito control activities outside the Twin Cities area.**

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<sup>12</sup> *Minn. Stat.* §473.716.

<sup>13</sup> In addition, state law contains language related to a statewide mosquito research program. In 1984, a Minnesota Mosquito Research and Control Program was established in response to a request by Governor Rudy Perpich. The Minnesota Department of Health, as the lead agency, brought together a group of North American experts to discuss problems related to mosquito research and control. This group recommended establishment of a state-wide research program housed in a research facility at the University of Minnesota supported by field research stations. Legislation was passed related to the research program, but funds were never appropriated to support it. (*Minn. Laws* (1Sp1985), ch. 14, art. 19, sec. 17 codified as *Minn. Stat.* §144.95.)

<sup>14</sup> *Minn. Stat.* §18.012. Mosquito control activity reported under this statute is summarized later in this chapter.

<sup>15</sup> *Minn. Stat.* §18.051.

<sup>16</sup> This historical summary relies on information from the Environmental Quality Board, Mosquito Control Technical Work Group, *Final Report*, April 1994: 1.



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**The  
Metropolitan  
Mosquito  
Control  
District's  
operations have  
been under  
public scrutiny  
for many years.**

insecticides in 1977. In 1985, environmental groups filed a lawsuit and a petition with the Environmental Quality Board (EQB) expressing concerns about the effects of the District's program and use of insecticides. As a result of additional concerns raised in the environmental review process, the District began a Supplemental Environmental Impact Statement which was completed in 1987.<sup>17</sup> The Supplemental EIS addressed the effects of changes in operations that the District had implemented since the original EIS.

In 1985, as a result of the lawsuit and petition, MMCD created and funded an independent Scientific Peer Review Panel (SPRP) to carry out an external research program on the effects of the District's larval insecticides. The 10-member panel was composed of experts in biology and toxicology from several universities in the United States and Canada, as well as state and federal researchers. Two panel members were named by environmental groups; the others were appointed by the MMCD.

EQB determined that the Supplemental EIS was adequate in June 1988, but also noted that potential impacts to certain nontarget species were unknown because of limited data. Therefore, EQB directed the District to prepare an addendum report on the SPRP research activities.

When MMCD did not complete the addendum report as expected in 1990, the environmental community prompted EQB to question the District about its research work in 1993. After a number of meetings, EQB decided that there were legitimate reasons for the delays, reaffirmed the need for information on environmental impacts of the mosquito control program, and raised issues concerning MMCD's effectiveness in reducing mosquito populations. In November 1993, EQB created the Mosquito Control Technical Work Group and directed it to identify and scope issues that should be addressed if the board were to hold a public hearing.<sup>18</sup> The work group consisted of staff members of EQB, MMCD, and other state agencies. After holding public meetings, the work group recommended, among other things, that EQB not hold hearings on the efficacy and environmental impacts of mosquito control because there were gaps in information. It also recommended that the District establish an interagency panel to review its effectiveness.

In the meantime, the SPRP conducted a variety of research projects, relying on a budget that ranged from \$210,000 to \$245,000 each year—2.5 percent of the MMCD budget.<sup>19</sup> Initially, the SPRP did laboratory studies on the effects of insecticides on mosquitoes and other species. It also examined the effects of insecticides in the field. In 1987, the SPRP began the Wright County Long-Term Experiment to study the effects of *Bti* and methoprene, the larval insecticides used by MMCD. The Natural Resources Research Institute (NRRI), a branch of the

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<sup>17</sup> Metropolitan Mosquito Control District, *Supplemental Environmental Impact Statement* [Draft], November 1986: ix-xiii.

<sup>18</sup> The Environmental Quality Board can hold hearings under authority of *Minn. Stat.* §116C.06 on matters of environmental significance.

<sup>19</sup> Scientific Peer Review Panel, "Interim Report," unpublished report to the Minnesota Environmental Quality Board, May 1993: 1, 3. Between 1987 and 1998, SPRP expenditures totaled over \$2 million.

University of Minnesota Duluth, worked closely with the SPRP to design the experiment. In December 1996, the District made presentations to EQB on the preliminary results of the SPRP research and the interagency panel's work on effectiveness. No action was taken by EQB. The SPRP issued its final report in January 1996 and then formally disbanded.<sup>20</sup>

A subgroup of the SPRP, the Continuation Panel, continues to meet but does not receive funding from MMCD. MMCD provided funding for continued treatment and sampling of the Wright County sites in 1997 and 1998. In 1997, a follow-up to the long-term study was done under contract by the Lake Superior Research Institute of the University of Wisconsin at Superior.

For some people, the results of this research eased concerns about the District's use of insecticides to control mosquito larvae. More recent criticisms of the District have focused on the insecticides it uses to control adult mosquitoes and whether people are provided with enough information about the District's operations.

## DISTRICT ORGANIZATION, FINANCING, AND STAFFING

The Metropolitan Mosquito Control District's mission is:

To promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner.<sup>21</sup>

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**The  
Metropolitan  
Mosquito  
Control  
Commission is  
the District's  
governing  
board.**

The District's primary emphasis is on mosquito control, which includes monitoring and control of human biting mosquitoes that can carry diseases or cause annoyance. The District emphasizes the control of mosquito larvae, with localized adult mosquito control to prevent disease transmission and reduce mosquito annoyance in public parks and at public events. MMCD also monitors and controls for black flies that cause human annoyance. Finally, it monitors deer ticks, which can carry disease, in the Twin Cities area.

Figure 1.1 shows the organization of the Metropolitan Mosquito Control Commission and the District. The Metropolitan Mosquito Control Commission sets policy for the District, delegating implementation to a professional staff. The Commission appoints a director who is responsible for managing the staff and operations of the District. By law, the director must be an entomologist.<sup>22</sup>

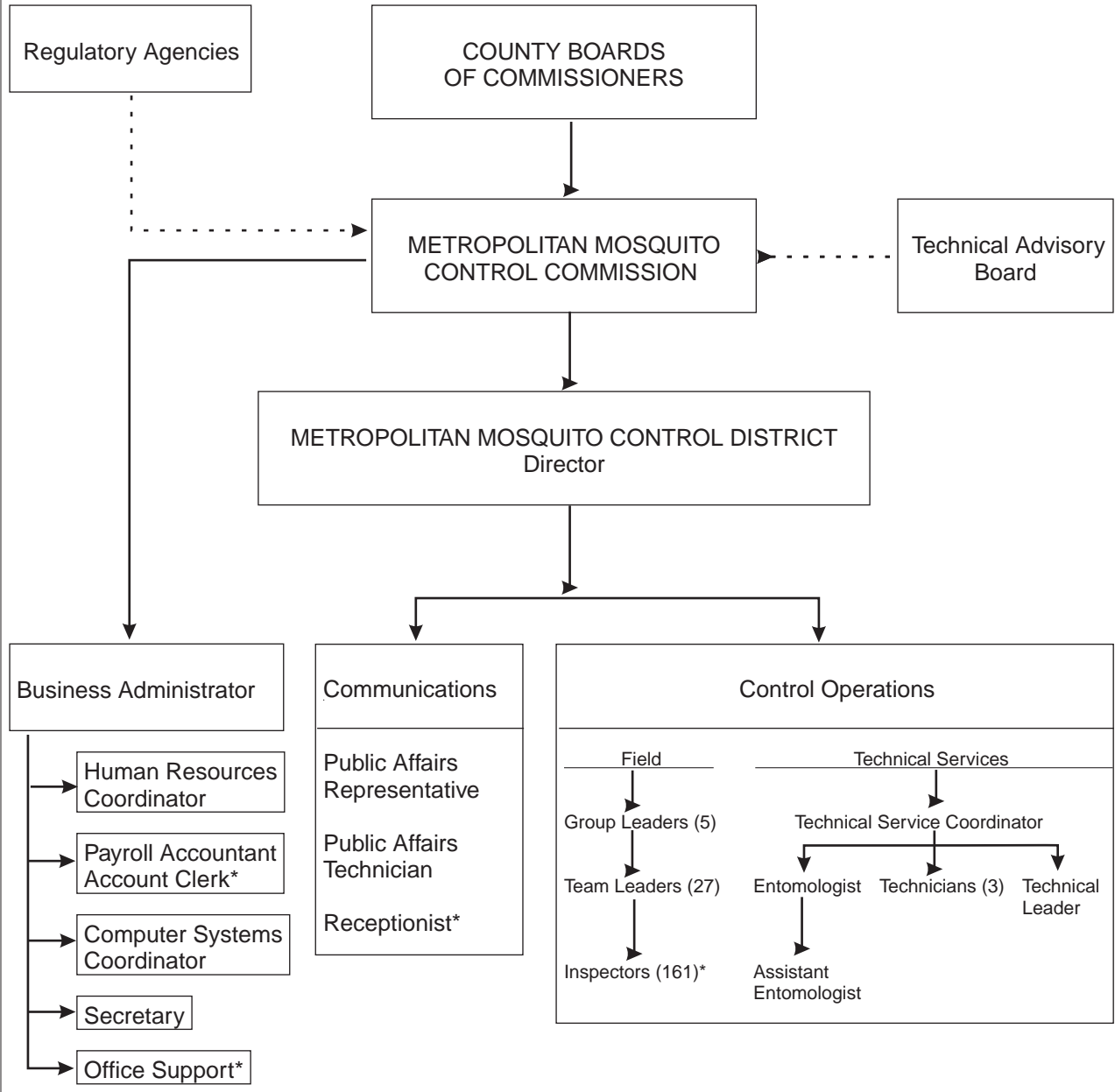
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<sup>20</sup> Results of the first few years of the Scientific Peer Review Panel long-term study were published in peer-reviewed journals in 1997 and 1998. The results of these and other studies are discussed in Chapter 2.

<sup>21</sup> Metropolitan Mosquito Control District, *1998 Budget*: 4. The Metropolitan Mosquito Control Commission amended the District's mission statement on May 22, 1996.

<sup>22</sup> *Minn. Stat.* §473.704, subd. 3.

**Figure 1.1: Metropolitan Mosquito Control District Organizational Chart, 1998**



\*Seasonal positions.

A Technical Advisory Board (TAB) reviews the goals, plans, operations, and research of the District and reports its recommendations to the Commission. The TAB is composed of technically-oriented professionals representing state agencies, the University of Minnesota, and industry and environmental groups. MMCD established the TAB in 1981 as a forum for cooperating with and obtaining advice from other public agencies as required by law.<sup>23</sup>

As a user of insecticides, the District is regulated by several federal and state agencies. The U.S. Environmental Protection Agency, the primary federal regulator, enforces the Federal Insecticide, Fungicide, and Rodenticide Act which provides for the registration, distribution, and use of pesticides.<sup>24</sup> In Minnesota, the Department of Agriculture regulates the registration, labeling, storage, and use of insecticides and the licensing of applicators pursuant to federal and state laws and rules. It also investigates citizen complaints and incidents involving the use of insecticides.

Other agencies that have a smaller role in insecticide regulation include: the Federal Aviation Administration for aerial applications; the Minnesota Department of Natural Resources for use in public waters; the Minnesota Department of Transportation for shipping of materials and signs on refueling vehicles; federal and state Occupational Safety and Health Administration for worker safety and protection; the Minnesota Pollution Control Agency for disposal of materials; and various local jurisdictions that have ordinances such as fire codes.

MMCD employed 47 full-time staff and 164 seasonal staff in 1998. Figure 1.1 illustrates the breakdown of staff by activity and shows that:

- **The majority of the District's staff have worked in insect control operations.**

The largest number of staff were responsible for monitoring and controlling insects from regional field offices: 32 full-time staff and 161 seasonal staff. The next largest group of staff was the technical services staff, consisting of seven entomologists and technicians, who provided scientific and technical support to the field operations. Under the supervision of the business administrator, four full-time staff provided personnel, accounting, and computer support to the District. Two full-time staff were responsible for communications, providing public information and education services and managing telephone calls from citizens. Three seasonal staff provided support to the administration and communication functions during the summer of 1998.

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<sup>23</sup> Chapter 5 examines governance issues related to the Metropolitan Mosquito Control Commission and the Technical Advisory Board.

<sup>24</sup> U. S. Environmental Protection Agency, *The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Food, Drug, and Cosmetic Act (FFDCA) As Amended by the Food Quality Protection Act (FQPA) of August 3, 1996* (Washington, D.C.: March 1997).

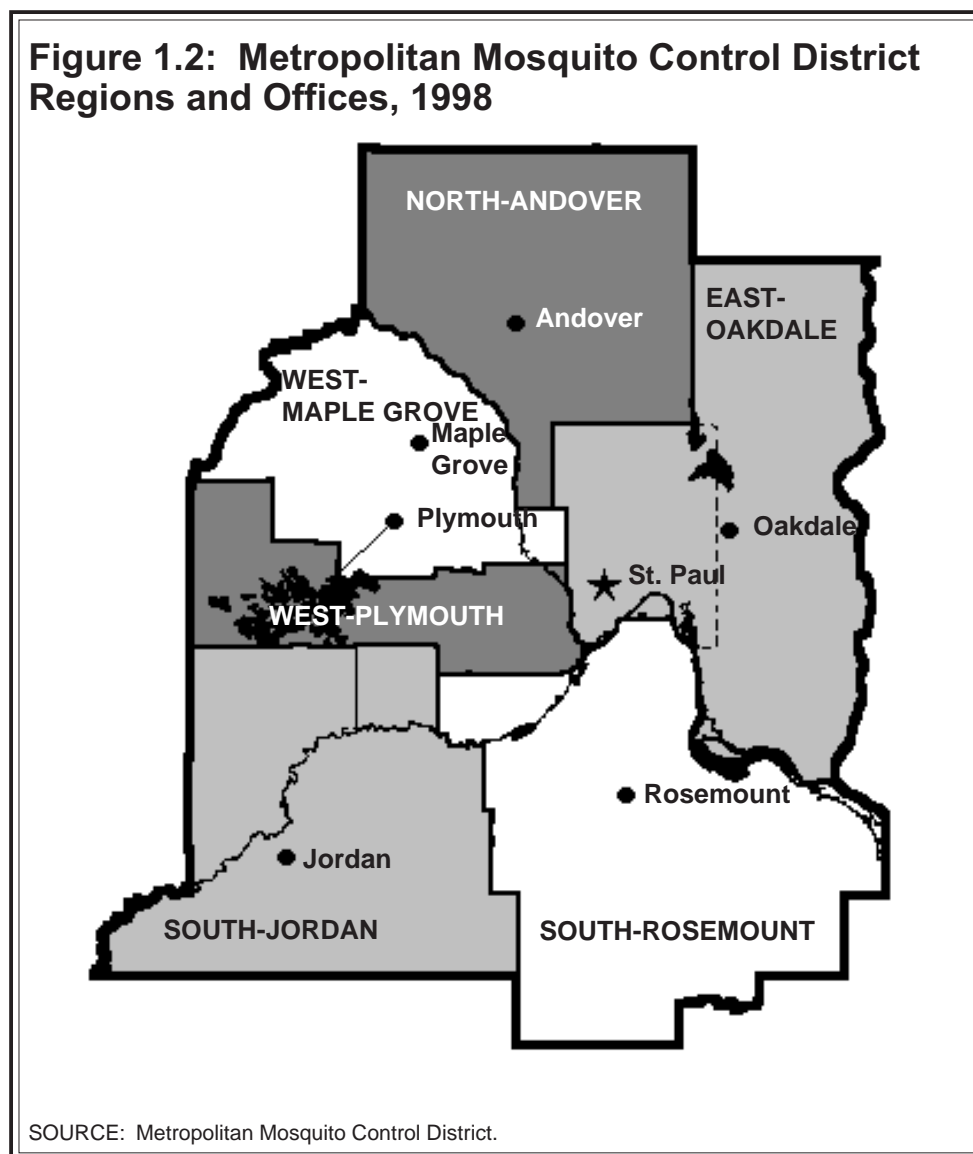
The District’s six regional offices and the areas they serve are shown in Figure 1.2. The District has divided the Twin Cities area into four regions: North, South, West, and East. The North and East regions each have a field office while the West and South regions have two offices each. Administration, communication, and technical services staff work out of the headquarters office in St. Paul.

### Changes in Revenues and Expenditures

The Metropolitan Mosquito Control Commission is a special taxing district, authorized to levy property taxes since 1982.<sup>25</sup> In 1998, MMCD had a budget of approximately \$8.6 million. The property tax levy accounted for 72 percent of

Six regional offices serve the District’s four regions.

**Figure 1.2: Metropolitan Mosquito Control District Regions and Offices, 1998**



<sup>25</sup> Minn. Stat. §473.711. Prior to 1982, each county in the District levied a special tax each year to defray its per capita share of the District’s costs.

1998 revenues, while state Homestead and Agricultural Credit Aid (HACA) accounted for 13 percent, and other miscellaneous revenues funded 4 percent.<sup>26</sup> In addition, about \$900,000 of the District's fund balance supported its 1998 operations. Hennepin County provided most of the District's property tax revenues (50 percent) in 1998 (see Table 1.1). The proportion of property tax revenues from each county has remained relatively consistent in recent years.

**Table 1.1: Metropolitan Mosquito Control District Budgeted Property Tax Revenues by County, 1998**

**The District's 1998 budget of \$8.6 million was financed primarily from property taxes.**

<u>County</u>	<u>Property Taxes</u>	<u>Share</u>
Anoka	\$ 525,800	8%
Carver	95,300	2
Dakota	801,300	13
Hennepin	3,129,500	50
Ramsey	1,056,400	17
Scott	159,100	3
Washington	<u>437,900</u>	<u>7</u>
Total	\$6,205,300	100%

SOURCE: Metropolitan Mosquito Control District, *1998 Budget*: 17.

Figure 1.3 shows the breakdown of MMCD's budget by activity for 1998. Insect control activities accounted for the largest share (89 percent) of the budget in 1998, of which about 44 percent funded salaries and wages.

Figure 1.4 shows the District's expenditures since 1990. In 1995, the Legislature reduced the District's revenues by 28 percent by reducing its property tax levy and state aid payments by 50 percent.<sup>27</sup> This resulted in a 22 percent reduction in actual expenditures in 1996. The District responded by laying off staff and reducing mosquito control services. The District's 1996 budget contained the following reductions: 16 percent for control operation salaries, 21 percent for administrative salaries, 40 percent for insecticides, and 76 percent for helicopter services. Since the budget reduction in 1996, the District's actual expenditures increased 11 percent between 1996 and 1997 and its approved 1998 budget increased 11 percent. As a result, the District's 1998 budget has approached its spending level in 1995, when its actual expenditures were \$8.8 million. This has been possible because in the past the District has not levied its maximum property tax levy and it has relied on its fund balance to support its operations.

In the late 1980s and early 1990s, the District had maintained a substantial fund balance—over \$15 million in 1989. MMCD has been criticized for using its fund balance to finance construction of a new headquarters building and regional offices between 1989 and 1994. Table 1.2 summarizes the District's 1989-94 construction projects and represents the current configuration of District offices.

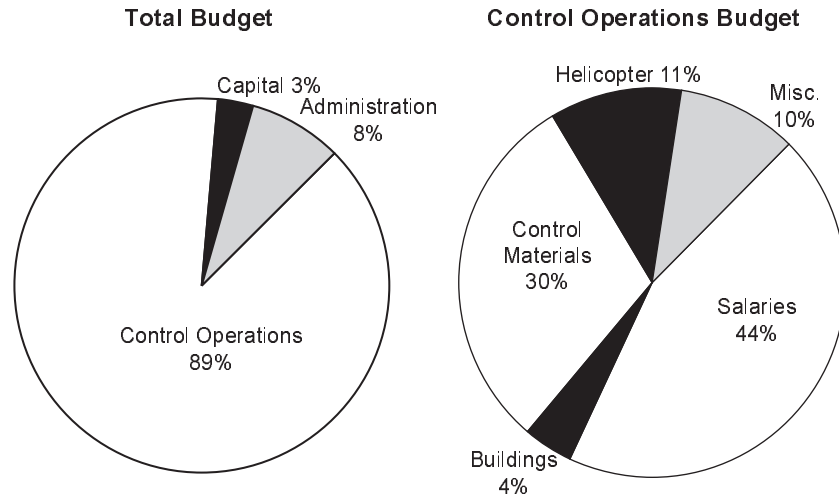
<sup>26</sup> Other revenues include investment income, delinquent tax income, and miscellaneous. MMCD has a January 1 to December 31 fiscal year.

<sup>27</sup> *Minn. Laws* (1995), ch. 255, art. 2, sec. 9.



**Mosquito control operations accounted for most of the District's 1998 budget.**

**Figure 1.3: Metropolitan Mosquito Control District 1998 Budget**

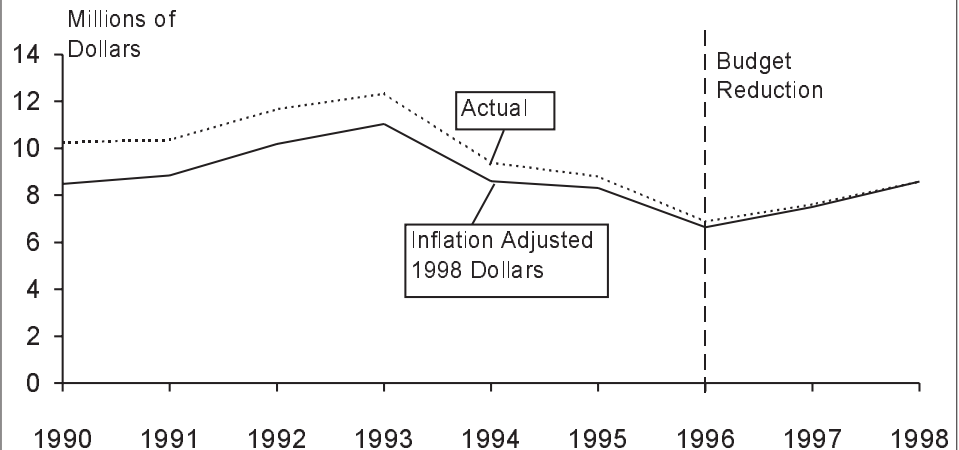


NOTE: Percentages do not sum due to rounding.

SOURCE: Metropolitan Mosquito Control District, 1998 Budget: 17-18.

**In 1995, the Legislature reduced MMCD's revenues by 28 percent, but current spending is close to pre-reduction levels.**

**Figure 1.4: Metropolitan Mosquito Control District Expenditures, 1990-98**



NOTES: Actual dollars were adjusted for inflation (to 1998 dollars) using the national price deflator for state and local government expenditures and gross investment. The 1998 data represent the District's approved 1998 budget.

SOURCE: Office of the Legislative Auditor, Metropolitan Mosquito Control District Financial Audits, 1990-97; and Metropolitan Mosquito Control District, 1998 Budget.

**Table 1.2: Metropolitan Mosquito Control District Buildings**

	Square Feet	Year Construction/ Remodeling Completed	Capital Cost of Land and Building
<b>Owned:</b>			
St. Paul Headquarters	36,284	1993	\$3,233,700
North Region - Andover <sup>a</sup>	16,090	1992	723,600
South Region - Jordan	23,600	1991	826,000
South Region - Rosemount	21,550	1994	1,044,370
West Region - Maple Grove <sup>b</sup>	20,800	1994	1,055,430
West Region - Plymouth <sup>c</sup>	23,810	1994	1,017,000
<b>Total</b>	<b>142,134</b>		<b>\$7,900,100</b>
<b>Leased:</b>			
East Region - Oakdale	30,680	--	--

<sup>a</sup>The District has a long-term lease with Anoka County for the land. Capital costs were for construction of a 10,250 square foot addition to an existing building.

<sup>b</sup>Capital costs were for land acquisition and remodeling of an 18,200 square foot existing building.

<sup>c</sup>Capital costs were for land acquisition and remodeling of an existing building.

SOURCES: Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for Fiscal Year Ending December 31, 1997*: 10-11; and R. Richard Gauger, "Metropolitan Mosquito Control District Construction Projects, 1989-1994: Final Report," December 30, 1994.

**The District used its fund balance to finance capital projects in the early 1990s.**

**The District's unreserved fund balance was \$6.1 million in 1997.**

The District's unreserved fund balance had declined to \$6.1 million in 1997.<sup>28</sup> The District had designated about \$2 million of its fund balance for control materials inventory, emergency disease control, and facility repair and maintenance.<sup>29</sup> However, these funds were not reserved (funds for which there is a legally-binding commitment). Comparing the District's unreserved fund balance with current expenditures helps place the fund balance in perspective. In 1997, the District's unreserved fund balance was 80 percent of its 1997 expenditures. The District's dependence on property taxes means that it receives most of its revenues in May and October of each year. State aid payments are distributed in July. District staff argue that the agency needs to maintain a sizable fund balance for cash flow purposes. Minnesota counties, with the same fiscal year and similar financing sources as MMCD, had unreserved general fund balances that averaged only 22 percent of total current expenditures in 1995, the most recent year data were available.<sup>30</sup>

<sup>28</sup> Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, June 1998: 1.

<sup>29</sup> In addition, \$500,000 for employee benefits is recorded in the general long-term debt account group.

<sup>30</sup> Office of the State Auditor, *A Guide to City and County General Fund Balances as of December 31, 1995*, July 1997: 2.

In December 1998, the Commission approved a 1999 budget of \$9.2 million, 7.4 percent higher than its 1998 budget. The Commission agreed to levy 100 percent of its property tax levy. The property tax levy will account for about 83 percent of total revenues, its highest share since 1990. The Commission also proposes to use a portion of its fund balance (about \$624,000) to make up the difference between the levy and the budget.

## Changes in Staffing

Between 1994 and 1996, the District changed its organizational and operational structure. Previously, staff had been assigned to individual programs, such as the cattail mosquito, black fly, and Lyme disease programs. Staff knowledge was specialized, assignments were focused on narrow, well-defined functions, and operations were highly compartmentalized.<sup>31</sup> MMCD used a continuous quality improvement process to move to a decentralized, team-based organization. Currently, there are 18 teams organized around 4 core process areas—control strategies management, technical support/resource management, public affairs, and human resources. Management and administrative teams provide support to other teams.

The reorganization was designed to streamline the agency, make more efficient use of resources, and provide more effective services. The goals of the reorganization were to make staff knowledgeable in many technical areas, provide the same knowledge in each regional office, increase ability of staff to address multiple problems, and create a more fluid and flexible organization. Another goal was to decentralize the agency. Instead of being managed out of the St. Paul headquarters, group leaders would coordinate the control activities from regional offices.

While the reorganization was initiated in 1994, the budget cut in 1996 accelerated its implementation and also required reductions in staff. Table 1.3 shows the change in staff complement by function since 1994. Full-time staff were reduced 19.5 positions (29 percent) between 1995 and 1996. Full-time staff in control activities were reduced 31 percent, with technical services staff and group leaders being cut. Legislation has protected 27 team leaders represented by a collective bargaining agreement from being laid off. In 1998, the District added 15 seasonal staff as it attempted to return to its pre-1996 service levels. The 1999 budget adds one full-time administrative support staff, for total employment of 48 full-time and 164 seasonal staff.

## Other Staffing Issues

One criticism of MMCD has been that it employs too many full-time staff given the seasonal nature of its work. We reviewed the responsibilities of full-time, year-round employees. In 1996, the District reduced its staffing and flattened its organization. In 1998, the District had eight administrative staff positions,

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**The District's 1996 budget cut resulted in a 29 percent reduction in full-time staff positions.**

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<sup>31</sup> Metropolitan Mosquito Control Commission Meeting, August 23, 1995, Agenda Item 5: Reorganization of MMCD.

**Table 1.3: Metropolitan Mosquito Control District Staff Complement, 1994-99**

Year	Full-Time Staff				Seasonal Staff	
	Administrative	Percent Change	Control Operations	Percent Change	Control Operations	Percent Change
1994	10	NA	62	NA	177	NA
1995	9	-10%	58	-6%	169	-5%
1996	7.5	-17	40	-31	141	-17
1997	8	7	39	-3	149	6
1998	8	0	39	0	164	10
1999 (proposed)	9	13	39	0	164	0

SOURCE: Metropolitan Mosquito Control District 1994-98 Budgets and 1999 Budget.

including the director, business administrator, and other administrative staff responsible for human resources, payroll, computer systems, public affairs, and office support. In addition, the District contracted for services that it either did not require on a full-time basis (such as legal and lobbying services) or that required certain technical expertise (such as black fly research and human resources policy work).<sup>32</sup> We concluded that:

- **It does not appear that the District has been over-staffed in its administrative area.**

Control operations staff are divided between technical services staff located in the headquarters office and field staff housed in regional offices (see Figure 1.1). In 1998, seven technical services staff were responsible for collecting and analyzing the information essential to the District's operations. Since the 1996 budget cut, the responsibilities of individual technical services staff have been expanded to absorb the responsibilities of terminated staff. The primary responsibilities of technical services staff include: 1) managing the laboratory which identifies mosquito and black fly larvae by species and development stage and analyzes the numbers and species of adult mosquitoes collected; 2) collecting and analyzing rainfall data; 3) staying up-to-date on scientific literature; 4) working with vendors and operating the control material certification program; 5) testing the efficacy of insecticides used by MMCD; and 6) testing new control materials.

The District employed 32 full-time field staff responsible for insect control activities in 1998: 5 group leaders responsible for managing 6 regional offices and 27 team leaders—between 4 and 7 in each regional office. One group leader managed both the Maple Grove and Plymouth regional offices. The group leader in the Rosemount office was also the District's specialist on insect-transmitted diseases. Each team leader was responsible for supervising between 4 and 6

<sup>32</sup> The District contracted for the following services in 1997: legal counsel, government relations/lobbying, accounting, black fly research and technical support, and human resources. The District spent approximately \$125,000 on consultant contracts in 1997.

seasonal staff during the summer. The team leaders are represented by Local 132 Construction and General Laborers Union of the AFL-CIO. A 1995 state law prevented the District from terminating employees covered under the terms of a collective bargaining agreement, except for cause, before January 1, 1999.<sup>33</sup>

While we cannot say whether MMCD employs too many full-time field staff, we did ask staff what tasks are accomplished in off-season periods. Full-time staff in the regional offices are discouraged from taking time off during the summer. Consequently, group leaders and team leaders take between four and six weeks of time in the winter through a combination of earned vacation and compensatory time off. Other off-season activities include: 1) LaCrosse encephalitis monitoring in fall and spring when foliage is gone; 2) cattail mosquito activities—breeding sites are monitored from September to November and insecticides are applied in February and March; 3) equipment repair and maintenance; 4) updating breeding site maps; 5) analysis of the past season's activities and updating breeding site section cards and computer files; 6) meetings for teams that do not meet regularly during the summer; and 7) computer training.

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### Seasonal staff begin working in April and May and stop working in late August or September.

Each year MMCD hires people to work on a temporary or seasonal basis. Most seasonal staff begin working in April and May and stop working in late August or September depending on weather conditions, mosquito populations, and budget. Some seasonal staff treat cattail mosquito breeding sites in February and March and monitor sites into October and November.

Seasonal staff are responsible for a number of different functions. Mosquito inspectors working out of the regional offices monitor and control mosquitoes. Technical services inspectors work in the laboratory at the headquarters office counting and identifying mosquito larvae and adults. In the past, some people have criticized the District for using its seasonal positions to provide political favors. Although we were not able to check every case,

- **We found no evidence that MMCD has used seasonal positions to provide political favors.**

Since 1996, responsibility for hiring seasonal staff has been decentralized; group leaders in each regional office are responsible for interviewing and selecting seasonal employees, with administrative support from the human resources coordinator at the headquarters office. Given the tight labor market in 1998, the Commission increased seasonal mosquito inspector salaries and aggressively recruited employees using a variety of advertising and outreach techniques.<sup>34</sup> State law forbids family members of Commission members from working at MMCD, and financial audit reviews of personnel records in 1996 and 1997 did not find a problem in this area.<sup>35</sup> However, in two instances over the past two summers, children of MMCD staff have worked as seasonal staff. We do not

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<sup>33</sup> *Minn. Laws* (1995), ch. 255, art. 2, sec. 14.

<sup>34</sup> In 1998, new hires started at \$8.35 per hour and employees with three or more years of experience were paid \$10.10 per hour. These wage rates were \$1.00 per hour higher than 1997 rates. Seasonal employees earned one paid holiday for every summer worked, were eligible for a shift differential for working evenings, and could earn overtime.

<sup>35</sup> *Minn. Stat.* §473.704, subd. 5.

know if any favoritism was involved in their hiring. In any case, the state law cited above does not apply to District staff. In neither instance was the individual assigned to work in the same office as their parent.

## BACKGROUND ON DISTRICT OPERATIONS

Mosquito control is MMCD's principal activity. Although there are about 50 species of mosquitoes in Minnesota, fewer than 34 occur in the Twin Cities metropolitan area.<sup>36</sup> The District's mosquito control efforts target about 15 mosquito species that are either aggressive human biters or potential carriers of disease. The mosquito control season starts May 1 and ends September 1.

Each mosquito species has a scientific Latin name and some species also have "common names." The characteristics of mosquitoes—such as breeding sites, number of generations, flight and feeding habits—vary by species. Each species requires unique environmental conditions to maintain its life cycle. Knowing the characteristics of each species is critical to using the proper control techniques. Figure 1.5 describes some characteristics of the mosquito species that are the focus of MMCD operations, including:

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**The District's mosquito control efforts target 15 mosquito species that are aggressive human biters or potential carriers of disease.**

- the floodwater mosquito (or *Aedes vexans*), the primary, most numerous human-biting mosquito species;
- the cattail mosquito (or *Coquillettidia perturbans*), which has the most persistent human-biting characteristics;
- the tree hole mosquito (or *Aedes triseriatus*), the primary carrier for LaCrosse encephalitis, a viral disease to which children are susceptible; and
- the *Culex tarsalis*, a carrier for Western Equine encephalitis, a viral disease affecting humans and horses and other livestock.

To understand how the District's control methods work, it is helpful to be familiar with the biology of the mosquito.<sup>37</sup> All mosquitoes need water to complete their life cycle. Different species of female adult mosquitoes show a distinct preference for breeding habitats in which to lay their eggs. The type of breeding habitat where mosquito larvae are found can be an aid to identifying what species they are.

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<sup>36</sup> Metropolitan Mosquito Control District, *Self-Assessment of Performance, 1994*, October 1994, 13.

<sup>37</sup> Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V, Mosquito Habitat, Biology and Terminology, Spring 1992; Roger Moon, "A Brief Overview": 7-9.



Only the female mosquitoes feed on humans and other animals because they require blood before they can develop eggs. Female mosquitoes feed on humans, domesticated animals, birds, and wild animals. Male mosquitoes feed on plant juices.

Mosquitoes have four life stages or cycles: egg, larva, pupa, and adult. Female mosquitoes lay eggs either on water or in damp soil that is likely to become submerged later. When conditions are right, the larvae emerge from the hatched eggs in the water. Mosquito larvae develop in still, shallow water and have four

**Figure 1.5: Mosquito Species, Breeding Sites, and Habitats**

<u>Species/Common Name</u>	<u>Nature</u>	<u>Breeding Sites</u>	<u>Habits and Habitats</u>
<i>Aedes vexans</i> <sup>1</sup> Floodwater mosquito	Primary annoyance pest, accounting for 40-80 percent of mosquitoes caught on humans.	Margins of grassy depressions, marsh edges, along river floodplains and woodland pools, damp ground.	Eggs hatch beginning in late April and early May; adult populations peak in June. More than one generation per year. A rainfall of one inch or more will raise water levels enough to cause eggs to hatch. Adults fly great distances (up to 40-50 miles). Depending on humidity and temperature, adults live between two and four weeks. Peak biting activity is at dusk.
<i>Coquilleltidia perturbans</i> Cattail mosquito	Second most abundant annoyance pest, accounting for half of mosquitoes caught on humans.	Cattail marshes.	Summer species that produces one brood per season. Larvae develop in cattail marshes over 12 months. Adults begin emerging in late June with peak emergence during the first week in July. Adults may fly up to five miles from breeding sites. Aggressive human biters with peak activity at dusk and dawn.
<i>Aedes (Ae) stimulans, Ae. abserratus, Ae. excrucians</i> Spring <i>Aedes</i>	Annoyance pest.	Woodland pools, bogs, marshes.	Develop in snowmelt water beginning in early April and emerge beginning in mid-May. First to emerge. One generation per year. Adult females live throughout the summer taking up to four blood meals. Do not fly far from breeding site.
<i>Anophele, Culex, Culiseta</i> Permanent water species	Annoyance pest.	Permanent and semipermanent water.	Several hatches each summer. Adults prefer to feed on birds and livestock but will bite humans.
<i>Aedes triseriatus</i> Tree hole mosquito	Primary carrier for LaCrosse encephalitis.	Tree holes and artificial containers, such as waste tires.	Adults found in wooded and shaded areas. Stay within 1/4 to 1/2 mile from where they emerge. Typically do not leave the woodlot. Most active in the daytime. Not aggressive biters.
<i>Culex tarsalis</i>	Carrier for Western equine encephalitis.	Permanent and semipermanent water.	Produces several generations a year. In late summer, feeding shifts from birds to horses or humans.
<i>Aedes albopictus</i> Asian tiger mosquito	Carrier for several diseases.	Artificial containers.	Not yet established in the Twin Cities area. MMCD discovered in Scott County in Sept. 1996 at a used truck tire business.

<sup>1</sup>Other species of summer *Aedes* are also annoyance pests including *Ae. sticticus* and *Ae. trivittatus*.

SOURCES: Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V, Spring 1992; Metropolitan Mosquito Control District, *1996 Operational Review and Plans for 1997*, 15-17, 20-21.

growth stages known as “instars.” At the end of the fourth larval instar, larvae molt into pupae. During the cocoon-like pupal stage, the adult mosquito develops within the pupal skin. The pupae stay in the water and do not feed. This is important because it affects when insecticides can be applied to be effective. After about one week in the pupal stage, adults are fully formed. They break through and emerge from the pupal skin, resting for a short time on the water surface while their wings expand and dry. Then adult female mosquitoes fly off in search of blood. After taking a blood meal, adult female mosquitoes will search for a breeding site to lay their eggs and the cycle begins again. The aquatic life cycle takes 7 to 10 days, depending on weather conditions.

A number of factors influence the adult female mosquito’s blood feeding activities: humidity, wind, temperature, light, respiration, and body heat, among others. The primary blood feeding activity is between sundown and midnight during the summer, depending on the species. Optimum feeding conditions are temperatures above 55° F and humidity of 70 percent or higher. A second feeding period occurs around sunrise. Mosquitoes are active when favorable conditions exist through the night or when daytime conditions are overcast and humid.

The life span of adult mosquitoes depends on several factors, such as temperature, humidity, sex of the mosquito, and time of year. Most males live about a week; females survive between two and six weeks.

The District also controls black fly (or biting gnat) larvae which develop in Twin Cities area rivers and streams. Biting gnats do not transmit disease but they bite and annoy humans. In Minnesota, there are four species of black flies that are considered pests: *Simulium (S.) venustum*, *S. luggeri*, *S. meridionale*, and *S. johansenni*. Black flies need well-oxygenated water, found in moving rivers and streams, for survival. *S. luggeri*, the primary pest, breeds in the Crow, Rum and Mississippi rivers. *S. venustum*, the most aggressive human biter, breeds primarily in small streams, though some breeding sites have been identified on the Rum River. *S. meridionale* and *S. johansenni* breed in large rivers, primarily the Crow and Minnesota rivers. Figure 1.6 compares black fly species in Minnesota.

Black flies lay eggs on the surface of moving water or on submerged vegetation. The larvae attach to rocks, logs, or vegetation in the water and feed on suspended materials that flow to them. Depending on the species, black flies have four to eight instars, or developmental stages. Black fly larvae stop feeding in the last larval stage right before pupation.

Black flies emerge as adults throughout the spring and summer. *S. venustum*, the small stream species, typically emerges in April and has only one generation. *S. johansenni* emerges in May or June, and also has only one generation. The other two black fly species emerge as adults in May through August, and can have several generations if climatic and river conditions are favorable. Female black flies bite animals or humans because the flies need blood to develop their eggs. Different species prefer different hosts.

Finally, the District monitors the presence and distribution of deer ticks in the Twin Cities area and shares this information with the Minnesota Department of Health. The bite of an infected black-legged tick (*Ixodes scapularis*) can transmit

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**The District targets its black fly control efforts at four species that are considered pests.**

**Figure 1.6: Black Fly Species and Habitats**

	<i>Simulium venustum</i>	<i>Simulium luggeri</i>	<i>Simulium meridionale</i>	<i>Simulium johansenni</i>
Primary habitat	Small streams	Crow, Rum and Mississippi rivers	Crow and Minnesota rivers	Crow and Minnesota rivers
Emergence	April	May-August	May-August	May-June
Generations	One	Three or more	Three or more	One
Number of treatments	One in spring	Several	Several	One or two
Primary location(s) of adults	Anoka	Anoka, Hennepin, Ramsey	Scott, Carver, south Hennepin	Scott, Carver, south Hennepin

SOURCES: Program Evaluation Division telephone interview with Ken Simmons, Black Fly Program Consultant, September 24, 1998 and interview with John Walz, Black Fly Coordinator, June 8, 1998; Metropolitan Mosquito Control District, Orientation Information, April 1, 1998; Metropolitan Mosquito Control District, *Self-Assessment of Performance, 1994*, October 27, 1994: 24.

Lyme disease to humans. At the present time, there are no effective methods available to control deer ticks.

## Mosquito Breeding Sites and Priority Areas

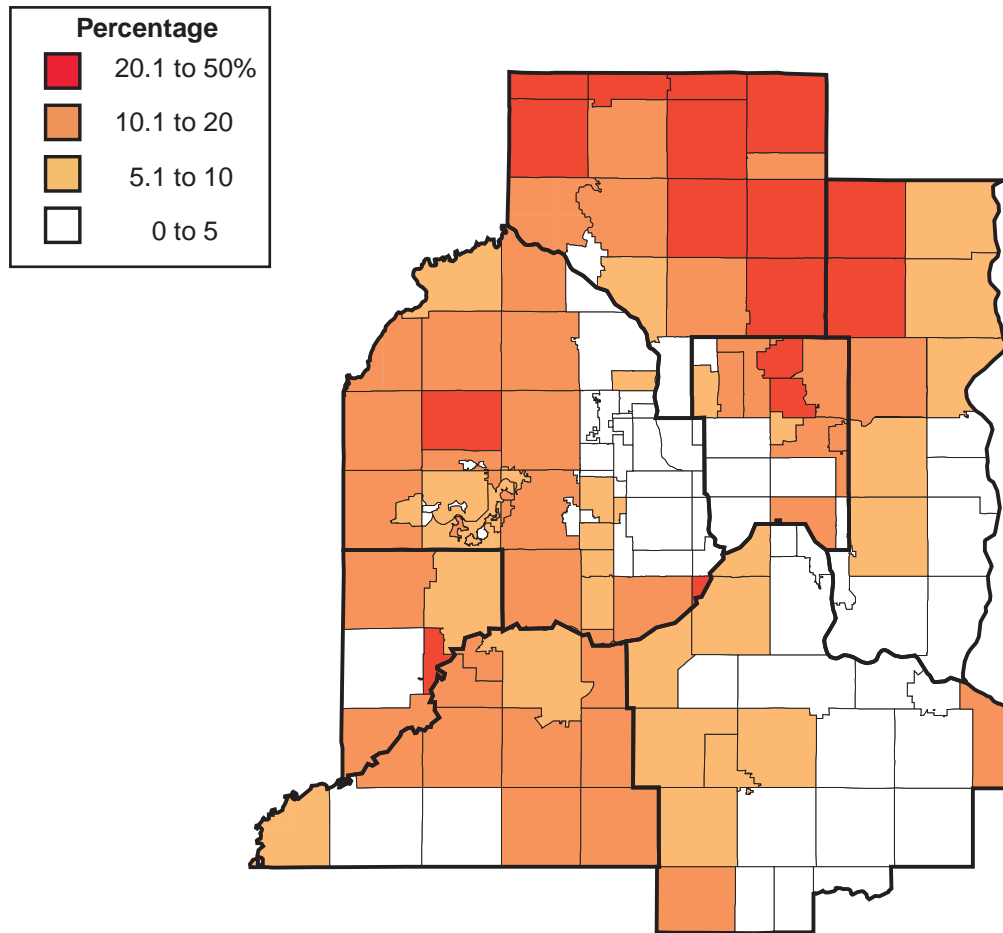
**The District has identified over 65,000 potential mosquito breeding sites covering about 189,000 acres.**

The Metropolitan Mosquito Control District covers an area of 2,600 square miles. The District has developed an extensive mapping system identifying over 65,000 mosquito breeding sites covering approximately 189,000 acres in the Twin Cities area. Mosquitoes breed in standing water, either temporary water or along the edges of permanent water. Mosquitoes are known to breed locally in the following areas: ponds which form as a result of snowmelt or rainfall; low areas that hold water and are dry for some of the year, such as woodland pools, ditches with wild grass, and areas with low grass; meadows and marsh sites that hold water all year; and cattail margins of permanent water sites. For those mosquitoes that develop in temporary water, a “breeding site” can be just about any place which will hold water for 10 to 15 days after a rainfall.<sup>38</sup> The mapped breeding sites within District boundaries range in size from about 400 square feet to 600 acres, with the average size of 2.87 acres. Figure 1.7 shows the percentage of acres in each township that were mosquito breeding acres in 1997.

The number of breeding sites and acres is not the same as the number of sites and acres MMCD treats to kill mosquito larvae. Other factors, such as whether Minnesota is having a wet year or whether the breeding site is in a refused treatment area, will affect the frequency with which sites will be treated or if they will be treated at all. The identified number of breeding sites may change as the Twin Cities area continues to develop, with some being created while others are destroyed.

<sup>38</sup> Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter V; Metropolitan Mosquito Control District, *Supplemental Environmental Impact Statement [Draft]*, November 1986: xi.

**Figure 1.7: Mosquito Breeding Acres As a Percentage of Each Township, 1997**

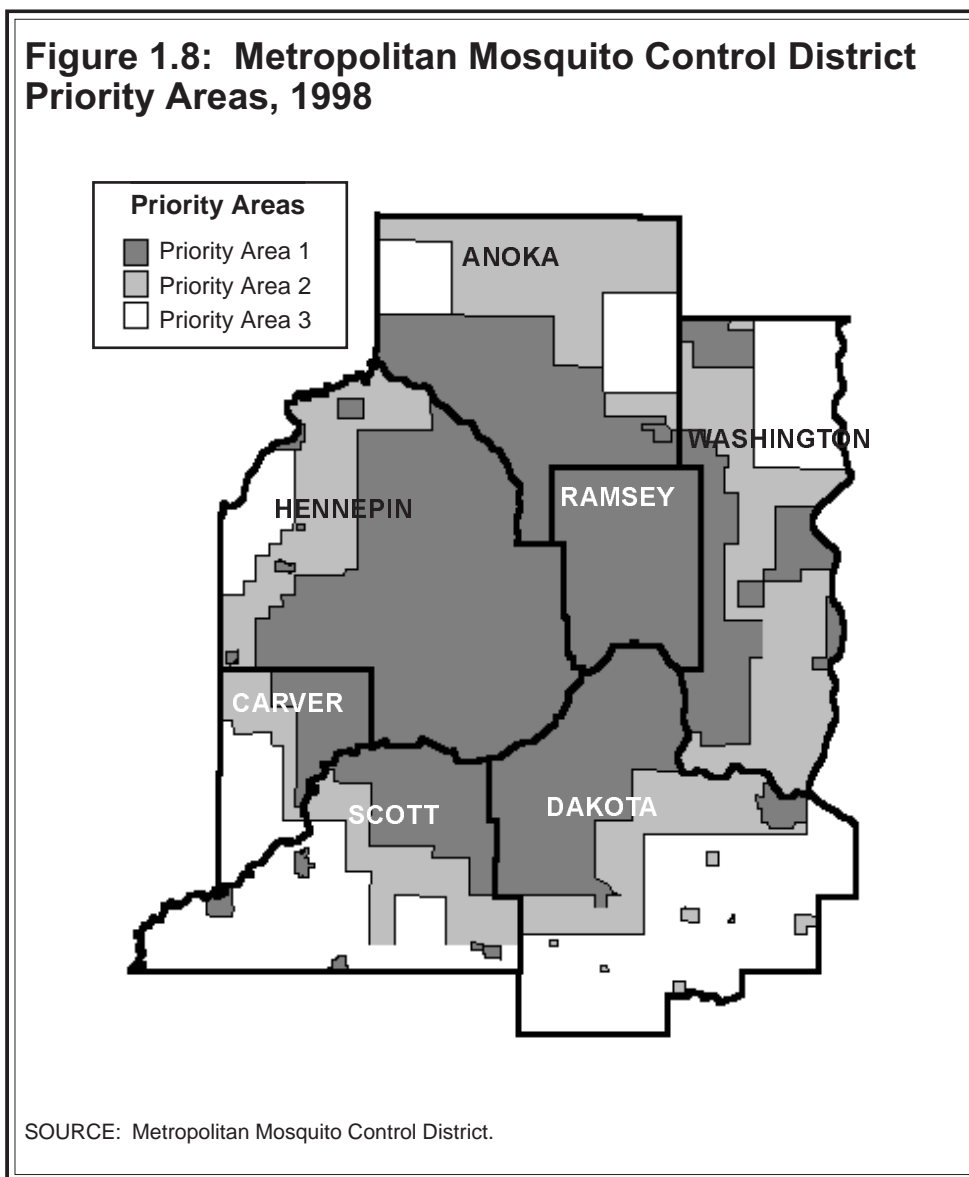


SOURCE: Metropolitan Mosquito Control District.

To help focus its mosquito control efforts, the District has established “priority areas” based on the location of mosquito breeding sites and human population density. Figure 1.8 shows the District’s priority areas for 1998, and Table 1.4 shows the distribution of mosquito breeding sites and acres by county in 1997. Most of the mosquito breeding acres were located in Anoka and Hennepin counties (northern and western sections of the Twin Cities area). Priority Area 1,

Based on the location of mosquito breeding sites and human population density, the District focuses its control efforts on three priority areas.

**Figure 1.8: Metropolitan Mosquito Control District Priority Areas, 1998**



the highest priority, accounted for over one-third of all breeding acres. Hennepin and Anoka counties accounted for most of the acres in Priority Area 1, 35 percent and 19 percent, respectively. However, all of Ramsey County’s mosquito breeding acres were in Priority Area 1.

The location of priority areas has changed over the years to correspond with changes in District control strategies and changes in population. For instance, the District used two priority areas in 1995. In 1996, the District added Priority Area 3 and Priority Area 1 and 2 “satellites,” which include population centers located in Priority Areas 2 and 3 such as Jordan, Hastings, Forest Lake, Rogers, Randolph, and Hampton. In 1997 and 1998, the District modified but did not significantly change the priority areas.

**Table 1.4: Mosquito Breeding Sites and Acres by County and Priority Area, 1997**

County	Total Sites	Acres			
		Total	Priority Area 1	Priority Area 2	Priority Area 3
Anoka	11,185	58,815	12,977	31,340	14,498
Carver	3,133	8,191	2,058	3,117	3,016
Dakota	6,633	15,986	6,702	2,883	6,401
Hennepin	18,694	41,522	23,901	15,168	2,453
Ramsey	4,925	10,840	10,840	0	0
Scott	9,490	27,177	8,489	8,331	10,357
Washington	11,797	26,431	3,034	18,137	5,260
Total	65,857	188,962	68,001	78,976	41,985

SOURCE: Program Evaluation Division analysis of the Metropolitan Mosquito Control District master breeding site data file.

## Control Methods and Insecticides Used by MMCD

**In the mid-1980s, MMCD switched to insecticides better targeted to mosquito and black fly larvae.**

MMCD uses *Bacillus thuringiensis israelensis* (*Bti*) and methoprene to kill mosquito larvae and resmethrin and permethrin to kill adult mosquitoes. MMCD began using these insecticides in the mid-1980s.<sup>39</sup> Prior to that, it had used the organophosphates temephos (sold under the trade name Abate), and chlorpyrifos (sold as Dursban), malathion, and petroleum oil. These products are still on the market. Until 1968, MMCD spread DDT and oil on water at breeding sites to kill mosquito larvae.<sup>40</sup> According to District staff, the District has chosen to use *Bti* and methoprene to kill mosquito and black fly larvae because these insecticides are less likely to harm nontarget species than broad spectrum synthetic chemical pesticides. This section presents information on how MMCD applies each material. Chapter 2 reviews scientific literature on the effects of these insecticides.

### *Bti*

*Bti* is a natural soil bacteria that kills mosquito and black fly larvae when they eat it. MMCD uses a dry formulation of *Bti* that is attached to corncob granules to kill mosquito larvae. To be effective, *Bti* must be applied during the first three instars of the mosquito life cycle before the larvae stop feeding. Given the development of mosquito larvae, after a rainfall of one inch or more MMCD has between 7 and 10 days to treat breeding sites. Prior to applying *Bti* to a mosquito breeding site, a MMCD inspector verifies that human-biting mosquito larvae are

<sup>39</sup> John Genereux and Michelle Genereux, "Minnesotans Flee for Cover When Mosquito Season Opens," *Pest Control*, March 1985.

<sup>40</sup> Citizens League, *Citizens League Report on Metropolitan Mosquito Control District*, 1966.



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**MMCD uses *Bti* (a natural soil bacteria) and methoprene (a synthetic growth regulator) to kill mosquito larvae.**

present in sufficient numbers and that they are not yet in the fourth instar. If these conditions are met, MMCD staff spread *Bti* in the water. Generally, areas over three acres are treated by helicopter and smaller areas are treated by ground crews using seeders or power backpacks. Dosage rates of five or eight pounds per acre are used.

MMCD uses liquid *Bti* to kill black fly larvae in rivers and streams. The *Bti* is poured into a stream or river if larval numbers meet or exceed thresholds established by MMCD and DNR and the larvae are at the right stage of development. The amount of *Bti* liquid used in a treatment depends on the river flow level on the day of treatment. MMCD uses *Bti* products with the trade names VectoBac G (the corncob granules) and VectoBac 12AS (the liquid) supplied by Abbott Laboratories.<sup>41</sup>

### **Methoprene**

Methoprene is a synthetic growth regulator (or juvenile growth hormone) used to kill mosquito larvae. MMCD uses several different formulations of methoprene including: 150-day and 90-day timed-release briquets, 30-day timed-release pellets, and liquid.<sup>42</sup> In its timed-release forms, methoprene will kill successive mosquito broods without requiring staff to revisit a site, and it can be used in breeding sites that are difficult to reach with a timely application of *Bti*. Unlike *Bti*, methoprene can be placed on dry areas. Rains that flood mosquito eggs, permitting them to hatch, will also flood the methoprene briquets or pellets releasing the active ingredient.

MMCD uses methoprene to control both cattail and floodwater mosquitoes. The briquets are applied by hand to sites that are three acres or less in size and are hard to access. Sites that may flood and then dry up are treated completely, while permanent wetland sites are treated with briquets to the perimeter. For cattail mosquitoes, briquets are applied in the winter and early spring when water is still frozen. Application rates are 220 briquets per acre for a floodwater mosquito breeding site and 330 or 440 briquets per acre for cattail mosquitoes.

Pellets may be applied by helicopter to sites larger than three acres to kill both floodwater and cattail mosquitoes. The application rates vary by species—2.5 pounds per acre for floodwater mosquitoes and 5 pounds per acre for cattail mosquitoes. Sites smaller than three acres are treated by ground crews by hand, seeder, or power backpack. MMCD uses methoprene products supplied by Sandoz Agro, Inc. under the trade name Altosid.

### **Resmethrin**

Resmethrin is a synthetic pyrethroid insecticide used to kill adult mosquitoes. MMCD applies resmethrin using ultra-low-volume foggers mounted on a truck or all-terrain vehicle or hand-held fog machines. The application rates vary by type

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<sup>41</sup> MMCD issues competitive bids each spring for the purchase of insecticides. The District also follows quality assurance standards to test insecticides. See discussion in Chapter 4.

<sup>42</sup> The 90-day timed-release pellets were used in 1998 only.

**MMCD uses  
resmethrin and  
permethrin  
(synthetic  
chemicals) to  
kill adult  
mosquitoes.**

of application—1.5 ounces per acre by fogger and 2.5 ounces per acre by hand-held machine. The insecticide fog contacts mosquitoes as they are flying, causing immediate knock down. Fogging is done either at dusk or in the early morning when mosquitoes are active. Resmethrin degrades rapidly in ultraviolet light.

MMCD uses a resmethrin product with the trade name of Scourge supplied by Clarke Mosquito Control Products. The U.S. Environmental Protection Agency (EPA) classifies Scourge as a restricted-use pesticide. Only certified applicators may purchase and use restricted-use pesticides for community mosquito control. Piperonyl butoxide (PBO) is an active ingredient in Scourge. When combined with resmethrin, PBO acts as an insecticide synergist and enhances the effectiveness of resmethrin by blocking detoxifying enzymes in an insect. EPA classifies PBO as a Group C carcinogenic risk, using the scale summarized in Figure 1.9.

### Figure 1.9: EPA Categories of Carcinogen Risk

Group A	Human carcinogen. Sufficient evidence from epidemiologic studies supports a causal association between exposure to a product and cancer. Federal law prohibits registration and use of any pesticide that has been classified as a “human carcinogen.”
Group B	Probable human carcinogen. Human and/or animal studies support a statistical linkage between exposure to a product and cancer. This is often expressed as statistical odds (such as 1 in a million) of developing cancer as a result of contact with the product.  Group B has two subgroups: B1 -- based on limited evidence from human epidemiologic studies. B2 -- based on sufficient evidence from laboratory animal studies.
Group C	Possible human carcinogen. Limited evidence of carcinogenicity in animals in the absence of human data. The link is weak and additional research may be warranted.
Group D	Not classifiable as a human carcinogen. Inadequate human or animal evidence of cancer-causing link or no data are available. Preliminary routine testing does not show a link to justify additional research.
Group E	Evidence of noncarcinogenicity for humans. No evidence supports an association between exposure to a product and an increased risk of cancer.

SOURCE: Guidelines for Carcinogen Risk Assessment, *Federal Register* 51 (185): 33992-34003, Sept. 24, 1986.

## Permethrin

Permethrin is also a synthetic pyrethroid used to kill adult mosquitoes in known daytime resting or harborage areas, such as wooded areas with good ground cover that provide a shaded, moist area. MMCD mixes permethrin with soybean and a food-grade mineral oil and applies it with a power backpack mister. The application rate is 25 ounces of diluted mixture per acre. Permethrin is applied and adheres to foliage; mosquitoes become exposed to it as they enter and leave the harborage area or land on the foliage. The product label says that permethrin provides control for up to 14 days; however MMCD research concluded that the control achieved by permethrin was significant for up to five days.<sup>43</sup> EPA classifies permethrin as a Group C possible human carcinogen. MMCD uses a product with the trade name Permethrin 57% OS supplied by Clarke Mosquito Control Products.

## MOSQUITO CONTROL IN OTHER PARTS OF MINNESOTA

The Local Pest Control laws (*Minn. Stat.* §§18.021-18.022) authorize local units of government in Minnesota outside the Twin Cities area to fund pest control activities, including mosquito control. The Department of Agriculture requires that communities submit a pest control application each year if they intend to provide pest control. Reviewing these applications, we found that:

- **Relatively few Minnesota cities outside the Twin Cities area have provided mosquito control services.**

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**Forty-nine cities outside the Twin Cities area said they intended to provide mosquito control services in 1998.**

Mosquito control services have been provided at the discretion of local government. A total of 44 cities with at least 171,000 in population indicated an intent to control pests in 1997 and 49 cities with about 168,500 in population were going to control pests in 1998. (Thirty-eight cities provided mosquito control services both years.) The largest cities were Moorhead, Faribault, and Red Wing. Most cities providing services are located in northwestern and central Minnesota. All but one city directed control efforts at mosquitoes during the years examined. Of these, all controlled for adult mosquitoes, while about one-third (16) of the cities also conducted some larval control each year. Mosquito control was conducted in these cities to minimize public discomfort from mosquito annoyance.

In the majority of cities (58 percent), the public works departments were responsible for mosquito control services in 1997 and 1998, followed by general government offices (21 percent). In most cities (77 percent), applicators were city employees.

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<sup>43</sup> Merry L. Holliday-Hanson, Chris E. Boxmeyer, Susan L. Palchick, "Residual Effects of Punt Applied as a Barrier Treatment Against *Aedes Vexans* in Wooded Areas in Minnesota," unpublished, Proceedings from 1992 California Mosquito Vector Control Association, 1992. These time limits apply to how long the insecticide will provide effective control. Neither the resmethrin nor permethrin product labels contain reentry limits.

## SUMMARY

The Metropolitan Mosquito Control District includes Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington counties and the eastern half of Carver County. While originally created to address mosquito control, the Legislature has given the District responsibility for controlling black flies and monitoring disease carrying ticks in the Twin Cities area. Based on a review of the statutes, it appears that the Legislature has intended mosquito control to be both a public service and a public health issue.

The District's mission is "to promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner." The Environmental Quality Board has reviewed several environmental impact statements related to MMCD's mosquito control programs. The District uses *Bti* and methoprene to kill mosquito larvae, and resmethrin and permethrin to kill adult mosquitoes. Recent criticisms have focused on the insecticides the District uses to kill adult mosquitoes.

The Metropolitan Mosquito Control Commission—composed of 17 commissioners from participating counties—sets policy for the District. MMCD provides mosquito control through six field offices located in four regions of the Twin Cities metropolitan area. In 1998, the District employed 47 full-time and 164 seasonal staff, the majority of whom worked in insect control operations. District operations and staff were cut in 1996 after the Legislature reduced the District's revenue by 28 percent. In each subsequent year, the District's budget has increased; the budget's current level of \$8.6 million is close to its 1995 level of spending, \$8.8 million.

We examined municipal pest control applications submitted to the Department of Agriculture and found that fewer than 50 Minnesota cities outside the District provided mosquito control services in 1997 and 1998. Usually public works departments were responsible for these services.

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# Safety Assessment of Insecticides Used to Control Mosquitoes

## CHAPTER 2

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**T**he effect of insecticides on humans and the environment is a primary issue in mosquito control. Our review addressed the following questions:

- **What does scientific research say about the effects of insecticides used by the Metropolitan Mosquito Control District on humans and nontarget species?**
- **What insecticides are used in other Minnesota cities and other states to control mosquitoes?**

To evaluate the safety of insecticides used by the Metropolitan Mosquito Control District (MMCD), we reviewed documents from the U.S. Environmental Protection Agency (EPA), articles from scientific journals, and research reports. To determine the insecticides used for mosquito control in other jurisdictions, we examined Minnesota Department of Agriculture municipal insecticide control data and we conducted telephone interviews with representatives of state agencies and mosquito control districts in other states.

Our conclusion from reviewing the scientific literature is generally consistent with EPA's position that the insecticides MMCD uses in mosquito and black fly larval control pose little risk to people and most nontarget species when used according to federally-mandated label instructions. A long-term study of Minnesota wetlands found that *Bti* and methoprene did not produce adverse effects on aquatic micro-organisms (such as zooplankton) or on the reproduction of red-winged blackbirds. Research results on the effects of these insecticides on midges, a nonbiting fly, were inconclusive.

Some scientists remain concerned about the insecticides MMCD uses for larval control because of the potential adverse effects on other species, especially midges. For some people this concern also extends to killing mosquitoes because they are part of the food chain in Minnesota wetlands. Limited scientific research has been conducted on the impacts of killing mosquito larvae on species higher on the food chain, such as wetland waterfowl.

The insecticides that MMCD uses to kill adult mosquitoes, resmethrin and permethrin, are controversial because they have the potential to harm other types of insects and aquatic organisms. The Minnesota Department of Health (MDH) assessed the risk of permethrin and resmethrin to humans and concluded that "exposure . . . through ingestion or skin contact does not pose a health risk to

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**It is not possible to reconcile different scientific perspectives about the need to use insecticides.**

humans . . . . Brief inhalation of the insecticides should not pose a health risk.”<sup>1</sup> The World Health Organization has also reviewed these insecticides and found them safe for humans and the environment when used at the recommended doses. Because permethrin and resmethrin are broad spectrum insecticides, however, they must be applied judiciously and in strict conformity with EPA label requirements. If the products are applied according to label directions they should not pose a health risk to humans.

The use of insecticides will alter the ecology of the environment by, if nothing else, killing mosquitoes. Some scientists recognize this and say that MMCD is using the most appropriate chemicals available for mosquito control. Other scientists, conservationists, and environmentalists argue that the use of any insecticides is unacceptable. One resource refers to this as the “pesticide problem” and states:

To a large degree, [the pesticide problem] is the result of disagreement among people about the need for pest control, about what environmental features deserve serious concern, about what pesticides ought to do, and about what side effects from them are tolerable.<sup>2</sup>

We are unable to reconcile these competing points of view because they represent different scientific perspectives and value judgments. Ultimately, decisions about whether to continue using insecticides for mosquito and black fly control are policy decisions that are most appropriately made by the Legislature using the best scientific information available.

## **BACKGROUND**

The main federal law on insecticide regulation is the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), which governs the registration, distribution, sale, and use of insecticides. The U.S. Environmental Protection Agency is responsible for its administration. EPA registers new insecticides and, sometimes, re-registers insecticides that have been on the market for many years. When considering insecticides for registration, FIFRA requires the Environmental Protection Agency to balance the risks of insecticides to humans and the environment against the benefits of using insecticides. If the benefits outweigh the risks, EPA may approve the insecticide for specific applications which must be stated on the product label. EPA makes its decision to approve an insecticide based on a review of scientific research, which is often carried out by the insecticide manufacturer. If the insecticide ends up in food, EPA must also set a tolerance or maximum limit on the amount allowed in food. EPA has established food tolerances for several of the mosquito control insecticides used by MMCD because they are also used in agricultural production.

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<sup>1</sup> Minnesota Department of Health, “Risk Assessment on Scourge and Punt Materials Used by the Metropolitan Mosquito Control District for the Control of Adult Mosquitoes,” March 17, 1993.

<sup>2</sup> Wayland J. Hayes, Jr. and Edward R. Laws, Jr., eds., *Handbook of Pesticide Toxicology* (San Diego, Calif.: Academic Press, Inc., 1991), 27.



Although EPA registered all the insecticides currently used for mosquito control many years ago, scientific research continues on the safety of these insecticides and their broader effects on the environment. Scientists have focused their work on the potential harm to nontarget species, such as other types of insects, frogs, ducks, and birds. Assessment of environmental impact requires looking at the effect on organisms directly exposed to insecticides as well as the effect on organisms higher up the food chain that might eat mosquitoes killed by insecticides or that might not have as many mosquitoes available to eat. The composition of an insecticide as it breaks down chemically is also an important environmental issue.

Several principles of toxicology bear on the research. Foremost is the question of dose. The *Handbook of Pesticide Toxicology* states:

Control of dosage is the basis for almost all safety in the use of chemicals. This rule applies not only to compounds of relatively high toxicity but also to compounds of low toxicity including those necessary to life.<sup>3</sup>

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**The dosage of an insecticide is a principal factor in determining the insecticide's toxicity.**

Table salt or even water could be toxic in large enough quantities. In contrast, humans can tolerate traces of potentially toxic chemicals. As with any drug or medicine, the amount of a pesticide that an organism takes in is critical to the pesticide's effect. Typically, there is a dosage level below which no observed harmful effect occurs, but as the dosage of a pesticide increases, harmful or toxic effects such as tumors, developmental irregularities, failure to reproduce, birth defects, or death may occur. The dose at which harm occurs may vary widely across species or it may be limited to certain organisms. In registering an insecticide, EPA establishes a dosage rate that is sufficient to be effective against specific insects but is no stronger than necessary to achieve the insecticide's purpose. In general, the smallest amount of insecticide necessary for control should be used. Federally-mandated insecticide labels specify the dosage rates.

The toxicity of an insecticide is also related to how an organism is exposed to it. In assessing risk toward humans, one must consider the effects of ingesting or inhaling an insecticide, and its effects should it come into contact with skin or eyes. Additionally, one must consider short-term and long-term effects. Typically, insecticides affect insects at certain stages in their life cycle. As discussed in the previous chapter, mosquitoes develop from eggs to larvae, pupae, and then adults. This is called a complete metamorphosis. Some insecticides are designed to kill mosquitoes in their larval stage, while others are used to kill adult mosquitoes. Furthermore, a mosquito passes through several developmental stages or "instars" during the larval stage, and an insecticide may be effective at only some of the instars. Generally, the more specific an insecticide is to a particular type of insect at a particular stage of its development, the safer it will be to other organisms.

Another important research consideration is how environmental factors modify the effectiveness and safety of an insecticide. Testing an insecticide in a laboratory is far different from applying it in a swamp. Once an insecticide is released in

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<sup>3</sup> Hayes and Laws, *Handbook*, 68-69.

natural surroundings, temperature, sunlight, pollutants, organic matter in water, and other factors can render it less effective against mosquitoes or change its effect on nontarget organisms. In our review, we examined both laboratory studies and research done in the field.

MMCD uses *Bacillus thuringiensis israelensis* (*Bti*) and methoprene to control mosquito larvae and resmethrin and permethrin, synthetic chemicals, to control adult mosquitoes. We found that:

- **MMCD uses insecticides that are approved by EPA for control of mosquitoes and black flies.**

Beginning with the insecticides used for larval control, the remainder of this chapter reviews the insecticides that MMCD uses to control mosquito and black fly larvae and adult mosquitoes. The final section of the chapter discusses alternatives to chemical control and insecticides used in other Minnesota cities and other states.

## LARVAL INSECTICIDES

MMCD's primary focus of mosquito control is to attack mosquitoes while they are still in the larval state. Since the mid-1980s, MMCD has used two insecticides to control mosquito larvae, *Bti* and methoprene.<sup>4</sup> *Bti* is also used to control black flies (or biting gnats) in their larval stage.

*Bti* and methoprene are both effective at killing mosquito larvae, but their method of killing larvae differs. *Bti* is more specifically a killer of mosquitoes than methoprene, which potentially has more adverse impact on other types of insects, depending on dosage and formulation. MMCD uses the two insecticides in different situations. *Bti* degrades rapidly in the environment and must be reapplied periodically, but methoprene comes in several timed-release forms that can persist in the environment for up to 150 days. MMCD uses timed-release forms of methoprene to treat isolated and hard-to-reach mosquito breeding sites.

### *Bti*

*Bacillus thuringiensis israelensis*, or *Bti*, is a naturally occurring soil bacteria. "*Israelensis*" is one of many different varieties of the *Bt* bacterium.<sup>5</sup> *Bti* has a microscopic crystal protein that is specific against mosquitoes, black flies, and midges. Once ingested, the crystal protein is activated in the insect's gut which is highly alkaline. The activated protein binds to receptors on cell membranes of the midgut, pores develop and cells break apart, and essentially the gut wall dissolves.

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<sup>4</sup> MMCD also conducts field tests of new products to determine if a product could be used operationally. For example, since 1997 the District has been testing a new larval control product called Laginex whose active ingredient is a fungus.

<sup>5</sup> F. G. Priest, "A Review: Biological Control of Mosquitoes and Other Biting Flies by *Bacillus sphaericus* and *Bacillus thuringiensis*," *Journal of Applied Bacteriology* 72 (1992): 357-369.

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***Bti* degrades rapidly in the environment and must be applied when mosquito larvae are feeding.**

The larva is not able to feed and dies.<sup>6</sup> Although *Bti* is a biological organism, it does not reproduce in the environment.

To be effective, *Bti* must be applied within a narrow window of opportunity in the development of mosquitoes. Typically, a rainfall of one inch or more will cover mosquito eggs that were laid earlier in damp earth at the edge of a depression, pond, or wetland. The eggs, covered by water, will hatch within one day, become larvae, then swim and feed in the water for six to eight days before they change to pupae and emerge as adults.<sup>7</sup> *Bti* must be ingested to be effective and mosquito larvae stop feeding at the fourth instar. *Bti* degrades within about a week in the water and must be reapplied when new broods of mosquitoes or black flies hatch.

EPA's registration process applies to all varieties of *Bacillus thuringiensis* (*Bt*). *Bt* is not toxic to birds, dogs, mice, rats, or other animals. Tests on humans verified its non-toxicity. It does not persist in the digestive systems of animals that may ingest it. It breaks down rapidly in the environment and poses no problems of residue or disposal.<sup>8</sup> It is not a threat to the groundwater, and EPA has issued no restrictions for its use around bodies of water. The EPA mandated product label specifies a range of dosage rates, up to 20 pounds per acre, depending on the site and larval stage of the mosquitoes. The label states that it cannot be applied directly to treated, finished drinking water reservoirs or drinking water receptacles.

EPA originally registered *Bt* in 1961 and re-registered it in 1998, taking into account new scientific evidence.

- **According to the new EPA assessment of *Bt*, “Toxicity and infectivity risks . . . to nontarget avian, freshwater fish, freshwater aquatic invertebrates, estuarine and marine animals, arthropod predators/parasites, honey bees, annelids, and mammalian wildlife will be minimal to nonexistent at the label use rates of registered *B. thuringiensis* active ingredients.”<sup>9</sup>**

## Minnesota Research on *Bti*

A 1989-90 study funded by the U.S. Fish and Wildlife Service at the Minnesota Valley National Wildlife Refuge tested the effects of *Bti* on chironomids, also called midges. Midges are nonbiting flies that are biologically similar to

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<sup>6</sup> Scientific Peer Review Panel, “An Assessment of Nontarget Effects of the Mosquito Larvicides, *Bti* and Methoprene, in Metropolitan Wetlands,” unpublished report to the Metropolitan Mosquito Control District, January 1996: 5.

<sup>7</sup> Claudia M. O'Malley, “*Aedes vexans* (Meigen): An Old Foe,” *Proceedings of the New Jersey Mosquito Control Association* (1990): 90-95.

<sup>8</sup> Extension Toxicology Network (EXTOXNET), “*Bacillus thuringiensis*,” revised 5/94, Pesticide Management Education Program, Cornell University, Ithaca NY, <<http://pmep.cce.cornell.edu/>>. This information is provided by a consortium of extension offices from Cornell University, Michigan State University, Oregon State University, and the University of California at Davis. The half life for *Bt* under normal sunlit conditions is 3.8 hours.

<sup>9</sup> Environmental Protection Agency, “R.E.D. Facts — *Bacillus thuringiensis*,” EPA-738-F-98-001 (Washington, D.C., 1998), 3.

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**Between 1986 and 1996, an independent research panel sponsored laboratory and field experiments on the effects of larval insecticides.**

mosquitoes and generally susceptible to the same insecticides. Midges are important to the environment as a high protein food for other species in the food chain, such as waterfowl. Under laboratory conditions, researchers observed that *Bti* adversely affected midges. However, when researchers applied *Bti* to enclosed ponds in the refuge at the normal dosage rate and at five times the normal rate, no adverse effects were seen on midge larvae or their emergence as adults.<sup>10</sup> This is an example of how laboratory and field experiments can show significantly different adverse effects on nontarget species.

As discussed in Chapter 1, the Scientific Peer Review Panel (SPRP), an independent research panel funded by the District, sponsored laboratory studies and field experiments between 1986 and 1996 to describe impacts of the insecticides used to kill mosquito larvae. The laboratory studies were designed to identify species that might be subject to adverse effects of insecticides used by MMCD. Results showed no adverse effects on crayfish and three species of frogs and toads that were fed *Bti*-killed mosquito larvae. However, one species of midge experienced high mortality at *Bti* concentrations near or below those that kill mosquitoes, although a longer exposure time was required, indicating a need to monitor midge populations in the long-term field experiment that followed.<sup>11</sup>

In 1988, SPRP supported three initial, short-term field studies. In one study, researchers from the Natural Resources Research Institute (NRRI) at the University of Minnesota Duluth, compared 10 mosquito breeding sites that had been treated with *Bti* for two or more years with 30 similar sites that had not been treated. The study examined the reproduction and growth of red-winged blackbirds, and the number and types of zooplankton, aquatic insects, and other species of invertebrates at the sites. Researchers detected no significant differences between the treated and untreated sites.<sup>12</sup>

In another study, a census of 26 types of birds compared 34 sites treated with *Bti* or methoprene with similar but untreated sites in 1988. Only yellow-headed blackbirds showed a lower population on treated sites. However, small changes in bird populations would probably not have been detected.<sup>13</sup> The researchers did not distinguish between sites treated with *Bti* and methoprene. In addition, many of the birds researchers examined were not dependent on wetlands and the small number of sample sites limited analysis.

In a subsequent experiment in 1988-89, NRRI researchers divided six small wetlands or ponds into three sections that were either treated with *Bti* or methoprene or left untreated. Analysis of the number and types of zooplankton, aquatic insects, and other invertebrates did not show significant changes between the treated and untreated areas. However, the densities of aquatic insects and invertebrates were too low to provide a rigorous test. Since the study only lasted

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<sup>10</sup> Colette Charbonneau, Ronald D. Drobney, and Charles F. Rabeni, "Effects of *Bacillus thuringiensis* var. *Israelensis* on Nontarget Benthic Organisms and Factors Affecting Efficacy of the Larvicide," *Environmental Toxicology and Chemistry* 13 (1994): 267-279.

<sup>11</sup> Scientific Peer Review Panel, "An Assessment," 1, 6.

<sup>12</sup> *Ibid.*, 12-13.

<sup>13</sup> *Ibid.*, 13-14.

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**The independent research panel designed a long-term study on the effects of *Bti* and methoprene on wetlands in Wright County.**

one year, it did not address the long-term effects of the insecticides.<sup>14</sup> Based on the above studies,

- **The Scientific Peer Review Panel concluded that no effects of [*Bti* and methoprene] on aquatic insects, on zooplankton, or on birds were seen in the initial, short-term SPRP field studies.<sup>15</sup>**

The relatively short time frame of the above studies led the Scientific Peer Review Panel to design a study to gauge the long-term effects of both *Bti* and methoprene. The project, called the Wright County Long-Term Experiment, started in 1987. SPRP initially contracted with NRRI to test these insecticides in 26 wetlands in Wright County, outside MMCD's control area. The experiment included two years of pre-treatment sampling of invertebrates (including aquatic insects, snails, and fingernail clams), zooplankton populations, and wetland birds, followed by three years of treatment (1991-93). It matched treated and untreated sites that were similar to each other before the experiment began. Researchers compared the sites as to the numbers, density, and diversity of insects and various aquatic micro-organisms. The researchers looked for food-chain effects by counting insects that prey on mosquito larvae and by studying breeding birds on the wetland sites. Red-winged blackbirds were chosen because they were the most abundant bird species common to most sites. However, red-winged blackbirds may not be the most useful sentinel species, because they are not a wetland dependent species.<sup>16</sup>

Two research groups have produced studies on the Wright County experiment. The first study, by NRRI, covered the first three years of treatment data (1991-93). The second study, by the Lake Superior Research Institute (LSRI) of the University of Wisconsin Superior, sampled the sites in 1997, after seven years of treatment. MMCD continued to treat the sites in 1998, making the Wright County experiment one of the few long-term studies that has been done on the effects of *Bti* or methoprene.

In its first research report and in related articles in scientific journals:

- **The Natural Resources Research Institute found that no adverse effects on aquatic micro-organisms (zooplankton), on the reproduction of red-winged blackbirds, or on the numbers of 18 other bird species could be associated with *Bti* and methoprene treatments.<sup>17</sup>**

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<sup>14</sup> *Ibid.*, 14.

<sup>15</sup> *Ibid.*, 2.

<sup>16</sup> *Ibid.*, 16-17.

<sup>17</sup> *Ibid.*, 2, 19, 29, 31; JoAnn M. Hanowski, Gerald J. Niemi, Ann R. Lima, and Ronald R. Regal, "Do Mosquito Control Treatments of Wetlands Affect Red-Winged Blackbird (*Agelaius phoeniceus*) Growth, Reproduction, or Behavior?" *Environmental Toxicology and Chemistry* 16, no. 5 (1997): 1014-1019.

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**Research on the effects of *Bti* and methoprene on midges, a nonbiting fly, has been inconclusive.**

Research results on the impacts to midges were inconclusive over the life of the Wright County experiment.<sup>18</sup>

- **NRRI found that after three years, *Bti* and methoprene had an adverse effect on the numbers of aquatic insects, particularly midges and other primitive flies.<sup>19</sup>**

By the end of the summer of the third year of treatment, the midge population had decreased to about 16 percent of that in untreated areas. The study found about the same level of adverse effects for *Bti* and methoprene.

However, LSRI came to a different conclusion after analyzing samples collected in 1997.

- **In sharp contrast to the previous study, and despite four more years of insecticide treatment, researchers from the Lake Superior Research Institute found few statistically significant differences in the numbers of midges between treated and untreated sites for either *Bti* or methoprene.**

One species of midge decreased but only in the last sample of the summer of 1997. No effects were seen on predator insects higher up the food chain. The authors concluded, “very few significant differences were observed, and certainly not in the major groups such as total macroinvertebrates, total insects, nematocera, chironomidae, and predators.”<sup>20</sup> This result applied to both *Bti* and methoprene.

Researchers in the two studies used different methods for finding and counting insects. The second research group demonstrated that its procedure resulted in more accurate insect counts by comparing the counts from samples using both methods. However, scientists told us that using different methods should not account for differences in research results. MMCD has contracted with LSRI for another year of research in 1998 on the same experimental sites.

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<sup>18</sup> In addition to these findings, the SPRP report (on pages 31-32) cites some issues with the design of the Wright County experiment that could limit the ability to generalize the results to MMCD’s entire control program. Some of these issues include: 1) the sites were not representative of all wetlands in the MMCD control program; 2) *Bti* was applied at a higher rate than used in normal MMCD operations; 3) it is puzzling that *Bti* and methoprene had similar levels of adverse effects, because they work in very different ways; and 4) red-winged blackbirds are not a wetland dependent species and therefore not representative of effects on other wetland dependent waterfowl.

<sup>19</sup> Scientific Peer Review Panel, “An Assessment,” 21, 24, 29, 31; G. J. Niemi, R. P. Axler, J. M. Hanowski, A. E. Hershey, A. Lima, R. R. Regal, and L. J. Shannon, “Evaluation of the Potential Effects of Methoprene and *Bti* (*Bacillus thuringiensis israelensis*) on Wetland Birds and Invertebrates in Wright County, MN, 1989 to 1993, Volume I,” Natural Resources Research Institute and Department of Biology, Department of Statistics, University of Minnesota Duluth, December 1995; Anne E. Hershey, Ann R. Lima, Gerald J. Niemi, and Ronald R. Regal, “Effects of *Bacillus thuringiensis israelensis* (*Bti*) and Methoprene on Nontarget Macroinvertebrates in Minnesota Wetlands,” *Ecological Applications* 8 (1998): 41-60.

<sup>20</sup> Kurt L. Schmude, Mary D. Balcer, and Ann R. Lima, “Effects of the Mosquito Control Agents *Bti* and Methoprene on Nontarget Macroinvertebrates in Wetlands in Wright County, Minnesota (1997),” Lake Superior Research Institute, unpublished: 26. Macroinvertebrates are invertebrates larger than 3 mm; nematocera are long-horned flies, such as crane flies. This study did not look at birds.



Although the long-term experiment had a strong likelihood of detecting declines of 50 percent or more in an insect population, it is possible that small declines in insect populations went undetected. The possible impact of small changes in an insect population on the broader environment is unknown, but insects often experience large variations in their populations because of natural causes.

In 1994, the Scientific Peer Review Panel contracted with LSRI to test the toxicity of *Bti* to midges, the nontarget insect most adversely affected in some previous studies. This study explored the effect of applying different doses of *Bti* in a pond, which would be similar to typical treatment sites. The research showed that some species of midges were more susceptible to *Bti* than others. Midge larvae had a significant reduction in abundance at 10 times the normal rate of *Bti*, but not statistically significant effects at 5 times the normal rate.

- **LSRI concluded that the application rates of *Bti* required for significant reductions in midge abundance were 2.5 to 5 times greater than the rates routinely used for mosquito control in Minnesota.**

The authors concluded that the normal application rate of *Bti* provides a reasonable margin of safety for midges.<sup>21</sup> The *Bti* application rates used by MMCD are either five or eight pounds per acres.

## Research on *Bti* in Black Fly Control

While mosquitoes breed only in standing water, black flies or biting gnats breed only in running water. Several species of black flies start their lives in local streams and rivers, including the Minnesota, Mississippi, Rum, and Crow rivers. When sufficient numbers of black fly larvae are found in a stream or river, MMCD staff pour a liquid form of *Bti* into the water. As *Bti* drifts downstream, it kills black fly larvae for a considerable distance, depending on the swiftness of the water.

The Minnesota Department of Natural Resources (DNR) issues the District an annual permit to apply liquid *Bti* in moving public waters. DNR required research on environmental safety as a condition of MMCD's permit to control black flies. Consequently, MMCD has conducted extensive research on *Bti* used to kill black fly larvae and its possible adverse effects on nontarget species.

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**The Department of Natural Resources required MMCD to study the effects of *Bti* liquid on the environment.**

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<sup>21</sup> Karsten Liber, Kurt L. Schmude, and Daniel M. Rau, "Toxicity of *Bacillus thuringiensis* var. *israelensis* to Chironomids in Pond Mesocosms," Lake Superior Research Institute, 1996, unpublished: 12-13, 17.

- A series of reports by MMCD shows that in flowing water, *Bti* had no adverse effects on a variety of nontarget organisms including mayflies, stoneflies, dragonflies, damselflies, beetles, and other two-winged flies. Its effect on midges, especially one species, was inconsistent.<sup>22</sup>

These findings are consistent with other studies that have found no negative impact of *Bti* on several nontarget insects when *Bti* is applied at recommended doses.<sup>23</sup> The most susceptible nontarget insects appear to be certain species of midges that, like black flies, are filter feeders.<sup>24</sup> Other studies have identified no adverse effects on selected fish and insects that feed on black fly larvae killed with *Bti*.<sup>25</sup>

## Methoprene

Although *Bti* might be the preferred insecticide for mosquito larval control, its short lifetime in the environment and the need to apply it within a few days after larval development begins limit its use. As an alternative, MMCD also controls mosquito larvae with methoprene. Typically, MMCD applies methoprene in the form of 150-day timed-release briquets or 30-day timed-release pellets that slowly dissolve in water. MMCD also uses a small amount of liquid methoprene.

Methoprene is a synthetic insect growth regulator that disrupts the normal development of some insects. Methoprene increases the concentration of growth hormone during the fourth larval instar, thereby disrupting the transformation to a pupa and killing the insect during the pupal stage. Methoprene may be less disruptive to the food chain in wetlands than *Bti* because it kills slowly, allowing

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**The District uses methoprene pellets and briquets that dissolve slowly in water.**

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22 Kenneth R. Simmons, "The Effects of *Bacillus thuringiensis* var. *Israelensis* (*Bti*) on Black Flies and Nontarget Invertebrates in Trott Creek and Cedar Creek," unpublished report, Metropolitan Mosquito Control District, February 1991; Kenneth R. Simmons, "Effect of Multiple Applications of the Bacterial Insecticide, *Bacillus thuringiensis* var. *Israelensis* (*Bti*) on Black Flies and Nontarget Invertebrates in the Mississippi River: Results of 1989 Studies," unpublished report, Metropolitan Mosquito Control District, June 1991; Kenneth R. Simmons and David Crews, "Effects of Three Years of Operational Control of the Black Fly *Simulium luggeri* with *Bacillus thuringiensis* var. *Israelensis* (*Bti*) on Nontarget Invertebrates in the Mississippi River," unpublished report, Metropolitan Mosquito Control District, October 1995; Kenneth R. Simmons and David Crews, "The Effects of Black Fly Control with *Bacillus thuringiensis* var. *Israelensis* (*Bti*) on Production of the Stonefly *Paragnetina media* (Walker) in the Rum River," unpublished report, Metropolitan Mosquito Control District, January 1996.

23 Mark S. Wipfli and Richard W. Merritt, "Effects of *Bacillus thuringiensis* var. *Israelensis* on Nontarget Benthic Insects and Through Direct and Indirect Exposure," *Journal of the North American Benthological Society* 13 (1994): 190-205; and Danial P. Malloy, "Impact of the Black Fly (Diptera: Simuliidae) Control Agent *Bti* on Chironomids (Diptera: Chironomidae) and Other Nontarget Insects: Results of Ten Field Trials," *Journal of the American Mosquito Control Association* 8 (1992): 24-31.

24 Malloy, "Impact of Black Fly," 29-30.

25 Mark S. Wipfli and Richard W. Merritt, "Low Toxicity of the Black Fly Larvicide *Bacillus thuringiensis* var. *Israelensis* to Early States of Brook Trout (*Salvelinus fontinalis*), Brown Trout (*Salmo trutta*), and Steelhead Trout (*Oncorhynchus mykiss*) Following Direct and Indirect Exposure," *Canadian Journal of Fisheries and Aquatic Sciences* 51 (1994): 1451-1458; Simmons and Crews, "The Effects of Black Fly Control."

more larvae to reach the pupal stage before they die and thus potentially be available for a longer time as prey for other species.<sup>26</sup>

Methoprene is registered for control of a variety of pests such as ants, flies, lice, moths, beetles, and fleas. As a pest control, it is used in the production of a number of foods, including meat, milk, eggs, mushrooms, peanuts, rice, and cereals. EPA has established a tolerance for methoprene in food products, so human exposure to methoprene is more likely to be from food than from mosquito control.<sup>27</sup>

EPA has recently issued new label requirements for the timed-release methoprene products. In previous years, these products were not to be used in known fish habitats. The current label removes that restriction.<sup>28</sup>

Methoprene has been studied extensively since the early 1970s and was first registered by EPA in 1975.

- **According to EPA, methoprene is of low toxicity and poses little risk to people and other nontarget species with the exception of estuarine invertebrates (such as shrimp) not found in Minnesota.**

Information on the use of the slow-release methoprene briquet is currently under review by the EPA because studies suggest that the use of this product in estuarine areas may cause undue risks to estuarine invertebrates. According to EPA's review, methoprene has shown no adverse effects on human health if ingested or inhaled, but may be slightly toxic if absorbed through the skin. No methoprene effects were seen in a two-year feeding experiment with rats. It does not cause tumors or cancer. It metabolizes rapidly and completely in mammals and somewhat more slowly in plants. It degrades rapidly in sunlight and soil, so it does not persist as a contaminant.<sup>29</sup>

Methoprene has shown no toxicity to mallards at relatively high doses, but it is moderately toxic to freshwater fish and some freshwater invertebrates, such as crayfish. Risks to fish are limited, however, because methoprene is not very soluble in water and it is not very persistent. When methoprene briquets dissolve in water, they produce a level of concentration far below the level that is hazardous to fish. Similarly, methoprene is potentially harmful to frogs, toads, and salamanders, but low dosage rates used in mosquito control should prevent harm to these species.<sup>30</sup>

Researchers in Florida tested the effect of multiple doses of methoprene on several nontarget organisms exposed over intervals from 20 days to 4 weeks in

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26 Mir S. Mulla, "The Future of Insect Growth Regulators in Vector Control," *Journal of the American Mosquito Control Association* 11 (1995): 269-273.

27 Environmental Protection Agency, "R.E.D. Facts—Methoprene," H-7508W, March 1991.

28 Product label for Altosid Pellets and XR Extended Residual Briquets, Sandoz Agro, Inc., EPA Reg. No. 2724-448-64833, April 1997.

29 Environmental Protection Agency, "R.E.D. Facts—Methoprene," H-7508W, March 1991.

30 Extension Toxicology Network (EXTOXNET), "Methoprene," revised 9/95, Pesticide Management Education Program, Cornell University, Ithaca NY, <<http://pmep.cce.cornell.edu/>>.

specially-designed ponds. Test organisms included freshwater shrimp, crayfish, mosquitofish, minnows, and dragonfly naiads. A comparison of organisms in treated and untreated ponds showed no differences in the number of organisms, their development, or their mortality rates. Researchers thought that if there was an adverse effect it might be seen in dragonflies, but that was not the case in either their larval or adult stages.<sup>31</sup>

## Minnesota Research on Methoprene

As discussed earlier, research sponsored by the Scientific Peer Review Panel focused on the environmental impacts of *Bti* and methoprene. Laboratory studies tested the effects of methoprene on water fleas, two zooplankton species, and leopard frogs. Under laboratory conditions, researchers found decreases in reproduction of one species of zooplankton when exposed to concentrations of methoprene about two times higher than the dosage rates used by MMCD. The other species of zooplankton was much less sensitive to methoprene, showing no effect at exposures two times the operational dosage rate, but some effects were seen at slightly higher rates.<sup>32</sup> In its mosquito control efforts, MMCD tries to achieve a concentration of two parts per billion of methoprene in the water. Based on laboratory results, researchers designed the subsequent field studies to test the effects of methoprene on zooplankton.

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**The independent research panel also studied the effects of methoprene on nontarget species.**

- **SPRP laboratory studies also showed that methoprene did not affect the development of frog embryos and larvae (tadpoles) until the dosages were many times greater than used in mosquito control.**

Researchers followed the development of tadpoles for 100 days, beginning 48 hours after their birth. Tadpoles were exposed to high levels of methoprene over that period. Researchers observed no adverse effects until the dosage rate was over 200 times normal mosquito control rates, at which point tadpole development was delayed and body mass was reduced. Tadpoles exposed to even higher doses of methoprene moved more slowly and less frequently than at lower doses, but none died.

A field study attempted to determine the effect of methoprene on the growth and development of mallard ducklings. Declining water levels hampered this study. SPRP members determined that the results from this study were inconclusive.<sup>33</sup>

Along with its analysis of *Bti*, NRRI compared 10 wetlands that had been treated with methoprene with 30 wetlands that had never been treated with insecticides. Researchers examined reproduction and growth of red-winged blackbirds and

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<sup>31</sup> Philip G. Hester, Carlisle B. Rathburn, Jr., and Arthur H. Boike, Jr., "Effects of Methoprene on Nontarget Organisms When Applied as a Mosquito Larvicide," (Department of Health and Rehabilitative Services, West Florida Arthropod Research Laboratory, Panama City, FL), Proceedings of the Florida Anti-Mosquito Association (nd): 16-20.

<sup>32</sup> Scientific Peer Review Panel, "An Assessment," 1, 10.

<sup>33</sup> *Ibid.*, 15. The Legislative Commission on Minnesota Resources helped finance the mallard duckling study.

numbers of aquatic insects and observed no differences between treated and untreated sites.<sup>34</sup>

The Wright County Long-Term Experiment looked at both methoprene and *Bti*.<sup>35</sup> As discussed previously, the two research groups analyzing the experiment reached different conclusions concerning the effects on midges. The first research report showed adverse effects for methoprene on some insects, particularly midges. The more recent study, however, found little or no significant adverse effects on midges between treated and untreated sites.

The long-term study was particularly important to assess methoprene effects because the timed-release formulations keep a steady level of methoprene in water (ideally two parts per billion) over extended time periods, up to an entire summer. In contrast, *Bti* degrades rapidly after application and had to be reapplied in the experiment. One might have expected to see more adverse results from methoprene than *Bti*, given that methoprene is released slowly in the water over a period of time. That was generally not the case, however, in either the first or second analysis.

Another MMCD experiment tested whether the methoprene briquets leave a residue in water from one year to the next. MMCD researchers found that the average 150-day briquet degraded to 19 percent methoprene after 150 days and completely degraded after 1.5 years under water.<sup>36</sup>

## Deformed Frogs

Concern about deformed frogs has heightened interest in methoprene as one of several possible causes. Much research is underway on this issue, and our review of the latest research shows that:<sup>37</sup>

- **So far, researchers have not been able to determine what causes frog deformities.**

Alternative hypotheses would implicate parasitic flatworms, ultraviolet light, or other chemicals in the water. Although frog deformities have been reported for hundreds of years, some scientists are pointing to methoprene as a culprit because

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<sup>34</sup> *Ibid.*, 12-13.

<sup>35</sup> Niemi et al., "Evaluation of the Potential Effects;" Hershey et al., "Effects of *Bacillus thuringiensis israelensis*;" Hanowski et al., "Do Mosquito Control;" Kurt L. Schmude et al., "Effects of the Mosquito Control Agents."

<sup>36</sup> Chris E. Boxmeyer, Sarah Leach, and Susan M. Palchick, "Degradation of Altosid XR Briquets Under Field Conditions in Minnesota," *Journal of the American Mosquito Control Association* 13 (1997): 275-277.

<sup>37</sup> Rodger Doyle, "Amphibians at Risk," *Scientific American* (August 1998): 27; Jocelyn Kaiser, "Deformed Frogs Leap Into Spotlight at Health Workshop," *Science* 278 (December 19, 1997): 2051-2052; Minnesota Pollution Control Agency web site at <<http://www.pca.state.mn.us>>; U. S. Geological Service and the North American Reporting Center for Amphibian Malformities web site at <<http://www.npwrc.usgs.gov/narcam>>.

one of the chemicals that can result when methoprene breaks down is similar to a natural biochemical called a retinoid or retinoic acid, found in many species.<sup>38</sup> Frogs and other organisms exposed to too much retinoic acid in laboratory settings can have developmental defects.

Research on methoprene in mosquito control has generally not looked at the breakdown products, except as they incidentally occur in the research situation. As discussed earlier, one local experiment showed that frog eggs and tadpoles exposed to high concentrations of methoprene in the laboratory did not have developmental defects.<sup>39</sup> One researcher asserts that, although retinoic acid can be produced from methoprene in a laboratory using a high level of ultraviolet light, it is unlikely to happen in the environment, where methoprene usually breaks down to other chemicals.<sup>40</sup> No one has demonstrated that when methoprene breaks down in the environment where it is applied for mosquito control that it produces enough retinoic acid to harm any species.

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**There appears to be no correlation between the locations of deformed frogs and methoprene use.**

We reviewed dates and locations of reported deformed frogs in Minnesota. Reports of deformed and normal frogs are available to the public along with other information on deformed frogs on an Internet web site of the North American Amphibian Reporting Center for Amphibian Malformations, which is maintained by the U.S. Geologic Survey.<sup>41</sup> This web site shows reports of deformed frogs from counties throughout Minnesota, suggesting that there is not a correlation at the county level between methoprene used for mosquito control and sightings of deformed frogs in Minnesota. Moreover, there were several reports from 1965 of deformed frogs in Washington County, yet methoprene was not discovered until 1968. If methoprene is related to frog deformities, it is clearly not the only cause. To date, however, there has not been a systematic accounting of frog deformities that would permit scientists to assess whether there truly are more frog deformities now than in the past, or whether there is an emerging trend.<sup>42</sup>

## ADULT MOSQUITO INSECTICIDES

In addition to larval control, MMCD controls adult mosquitoes in parks, at public events, in residential neighborhoods, and where disease carrying mosquitoes are found. MMCD uses two synthetic pyrethroid insecticides, resmethrin and permethrin, in adult mosquito control. These are known as broad-spectrum

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38 Margaret A. Harmon, Marcus F. Boehm, Richard A. Heymann, and David J. Mangelsdorf, "Activation of Mammalian Retinoid X Receptors by the Insect Growth Regulator Methoprene," *Proceedings of the National Academy of Sciences of the United States* 92 (June 20, 1995): 6157-6160.

39 Scientific Peer Review Panel, "An Assessment," 10.

40 David Sullivan, "Methoprene and Frogs," *American Mosquito Control Association (AMCA) Newsletter*, November 1997: 11-12.

41 <<http://www.npsc.nbs.gov/narcam>>.

42 As part of a dissertation research project, researchers from the Natural Resources Research Institute at the University of Minnesota Duluth conducted one census of frog populations in the Wright County experimental wetlands during the summer of 1998. Frogs were collected from sites treated with *Bti* and methoprene and untreated sites. The project also included examination of frogs from sites in two other states.



insecticides because they kill many types of insects in addition to mosquitoes. Pyrethroids mimic the structure of pyrethrins, a natural botanical insecticide found in chrysanthemum flowers. This similarity does not relate to the toxicity and persistence of synthetic pyrethroids however.

## Resmethrin

Resmethrin kills insects by paralyzing their nervous system; it can also kill insects that ingest it and larvae on contact. Resmethrin is registered for use by EPA and sold under various trade names.<sup>43</sup> Commercial formulations usually include other chemicals to enhance effectiveness against a wide variety of agricultural and household pests. Resmethrin is sold under the brand names Raid Flying Insect Killer and Ortho Outdoor Flying Insect Fogger, among other products. Resmethrin is also used to protect stored grain from insects. EPA classifies resmethrin as a restricted use pesticide because of its adverse effects on aquatic organisms. Only certified applicators may purchase and use restricted use pesticides for community mosquito control at aquatic sites because resmethrin is toxic to fish, but anyone can purchase resmethrin products designed and labeled for household uses.

For mosquito control, MMCD uses a product which is a mixture of resmethrin and piperonyl butoxide. Resmethrin is used to kill mosquitoes when they fly, usually at dusk or in early morning hours, when mosquitoes are most active. Piperonyl butoxide, an active ingredient in resmethrin, acts as an insecticide synergist when combined with resmethrin. It enhances the effectiveness of resmethrin by blocking detoxifying enzymes in mosquitoes. Resmethrin breaks down quickly in ultraviolet light; about half of it is gone in 15 minutes.<sup>44</sup>

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**Resmethrin is a restricted use pesticide because it is highly toxic to fish if improperly used.**

Resmethrin is highly toxic to fish and bees, and it is moderately toxic to humans by ingestion and slightly toxic through the skin. It is slightly toxic to birds.<sup>45</sup> It has not caused birth defects or cancers in animal studies, but EPA has not evaluated resmethrin for evidence of human carcinogenic potential.<sup>46</sup> EPA has established a tolerance for resmethrin in food.<sup>47</sup>

An international panel of experts affiliated with the World Health Organization reviewed the scientific literature on resmethrin.<sup>48</sup>

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<sup>43</sup> Extension Toxicology Network (EXTOXNET), "Resmethrin," revised 9/93, Pesticide Management Education Program, Cornell University, Ithaca NY, <<http://pmep.cce.cornell.edu/>>.

<sup>44</sup> *Ibid.*, 3.

<sup>45</sup> *Ibid.*, 2, 3.

<sup>46</sup> *Ibid.*, 2; Environmental Protection Agency, "IRIS Substance File: Resmethrin," March 1, 1997.

<sup>47</sup> 40 *Code of Federal Regulations* sec. 185.5300, revised July 1, 1997.

<sup>48</sup> World Health Organization, "Environmental Health Criteria 92: Resmethrins — Resmethrin, Bioresmethrin, Cismethrin," Geneva, 1989, 57. Published under the joint sponsorship of the United Nations Environment Programme, the International Labor Organisation, and WHO. This report also concluded that resmethrin's degradation products are unlikely to reach levels of environmental significance.

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**In 1993, the Department of Health conducted a risk assessment of the adult insecticides used by the District.**

- **The World Health Organization concluded that resmethrins were unlikely to present a hazard to the general public or attain levels of environmental significance when used under recommended conditions and rates for household and other public health use.**

In 1993, the Minnesota Department of Health (MDH) assessed the risks to humans of the insecticides that contain resmethrin and permethrin (discussed below) as used by MMCD for adult mosquito control.

- **The Minnesota Department of Health risk assessment concluded that “exposure to Scourge [resmethrin] or Punt 57-OS [permethrin] through ingestion or skin contact does not pose a health risk to humans under the scenarios described . . . Brief inhalation of the pesticides should not pose a health risk. Nevertheless, children should be prevented from having prolonged inhalation exposure to the pesticides.”**

MDH advised, for example, that children should not be permitted to follow the pesticide applicators as they work.<sup>49</sup> The risk assessment assumed worst-case scenarios for exposure to the insecticides and included a wide margin of safety for people who might be sensitive to the chemicals. Other assumptions included that MMCD treats parks, recreation areas, and residences, and areas within a quarter mile radius of those sites, and that high-use parks were treated a maximum of five times per summer at ten-day intervals. The assessment considered risks by accidental ingestion, inhalation, and skin contact for the insecticides; by accidental inhalation and ingestion for piperonyl butoxide; and by inhalation for oil solvents.<sup>50</sup>

## Piperonyl Butoxide

Piperonyl butoxide (PBO) is added to resmethrin in mosquito control applications to make insects more sensitive to the effects of resmethrin. Recent scientific studies done in Japan have shown that PBO can cause liver cancer in mice and rats.<sup>51</sup> This has raised concerns about whether PBO should continue to be used in insecticides and have a tolerance in food.<sup>52</sup> The Japanese research, however,

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<sup>49</sup> In the risk assessment, the Department of Health estimated a safe level of inhalation exposure. The risk assessment reflects an estimated air concentration of resmethrin that could be safely inhaled for up to four hours. It reflects an estimated air concentration of permethrin that could be safely inhaled for up to six hours. Because of a lack of data, it was not possible to calculate a safe 30 minute exposure level for either resmethrin or permethrin. The air concentration of resmethrin and permethrin that could be safely inhaled for only 30 minutes may be greater than the four or six hour concentrations. (Minnesota Department of Health, “Risk Assessment on Scourge and Punt Materials Used by the Metropolitan Mosquito Control District for the Control of Adult Mosquitoes,” March 17, 1993: 21-22, 25, 39-40, 41.)

<sup>50</sup> Minnesota Department of Health, “Risk Assessment,” March 17, 1993.

<sup>51</sup> O. Takahashi, S. Oishi, T. Fujitani, T. Tanaka, and M. Yoneyama, “Chronic Toxicity Studies of Piperonyl Butoxide in F344 Rats: Induction of Hepatocellular Carcinoma,” *Fundamental and Applied Toxicology* 22 (1994): 293-303; O. Takahashi, S. Oishi, T. Fujitani, T. Tanaka, and M. Yoneyama, “Chronic Toxicity Studies of Piperonyl Butoxide in CD-1 Mice: Induction of Hepatocellular Carcinoma,” *Toxicology* 124 (1997): 95-103.

<sup>52</sup> 40 *Code of Federal Regulations* sec. 185.4900, revised July 1, 1997.

found that before safety would be an issue, people would have to consume about 18,000 times the amount of PBO that the Japanese government currently allows daily in food products.

EPA's registration of PBO had been based on research showing no cancer causing effects, but in 1995 EPA reviewed the research and concluded that PBO should be classified as a possible human carcinogen.<sup>53</sup> So far, EPA's classification of PBO as a Group C carcinogen risk has not resulted in any restriction of use. The Minnesota Department of Health 1993 risk assessment included piperonyl butoxide. PBO was only evaluated for oral and inhalation exposure. The conclusions of the risk assessment summarized earlier also apply to PBO.

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**Permethrin and piperonyl butoxide, an active ingredient in resmethrin, are classified by EPA as possible human carcinogens.**

## Permethrin

Permethrin, a synthetic pyrethroid, is sold to the public in various commercial pesticide products. Trade names include Permethrin 57% OS and Pounce (for mosquito control), Duranon Tick and Insect Repellent, Permethrin Tick and Flea Killer for Dogs, and Spectracide Lawn and Garden Insect Control. Permethrin is the active ingredient in RID shampoo for head lice. As with resmethrin, it kills insects by paralyzing their nervous systems.

In mosquito control, permethrin is mixed with mineral oil and soybean oil and sprayed on leaves of bushes and plants where mosquitoes rest or hide during the day. Unlike resmethrin, permethrin is moderately long-acting; on foliage, it can take up to about ten days for half to be broken down.<sup>54</sup> According to the EPA label, it may provide control for up to 14 days in shaded woodland areas. Results of MMCD research found that control of mosquitoes that come in contact with treated foliage is significant for up to five days.<sup>55</sup>

The EPA label of the product used by MMCD states that permethrin is extremely toxic to fish and aquatic organisms and may not be applied directly to water. Because runoff into water may also be hazardous, it should not be applied within 100 feet of lakes and streams. The label also states that it is hazardous to bees and should not be applied where it can get onto blooming crops or weeds while bees are active in the treatment area. It should not be used on crops for food, forage, or pasture. The label specifies droplet size for fogging operations, depending on flow rate and vehicle speed when sprayed from a moving truck.

Permethrin has low toxicity to mammals, but contact with eyes, skin, or clothing should be avoided, and breathing of mist or vapors also should be avoided. Exposure to permethrin may sometimes cause a numbing, tingling, or burning

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<sup>53</sup> John Doherty, Ph.D. and Esther Rinde, Ph.D., Environmental Protection Agency, Office of Pesticide Programs, to Richard Keigwin and Alan Dixon/Bruce Sidwell, *Carcinogenicity Peer Review of Piperonyl Butoxide*, February 15, 1995, memorandum.

<sup>54</sup> National Pesticide Telecommunication Network, "Permethrin," Oregon State University, September 1997, <<http://ace.orst.edu/info/nptn/factsheets/perm7.htm>>. The typical half life of permethrin in soil is 30 days.

<sup>55</sup> Metropolitan Mosquito Control District, "1991 PUNT Residual Study," unpublished, 1992.

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**When used as recommended, resmethrin and permethrin are unlikely to pose a hazard to the general public.**

sensation that goes away within 12 hours. It is quickly metabolized (broken down) by humans and other animals.<sup>56</sup>

EPA has classified permethrin as a possible human carcinogen.<sup>57</sup> There was no evidence of cancer in long-term studies that fed large quantities of permethrin to rats, but a long-term feeding study of mice showed a slight increase in lung tumors among male mice. Permethrin is not toxic to birds except at very high doses. It is rapidly broken down by micro-organisms in the soil, so it will not contaminate groundwater. It is not harmful to most plants. EPA has set a tolerance for permethrin in agricultural products.<sup>58</sup>

An international panel of experts affiliated with the World Health Organization reviewed the scientific literature on permethrin.

- **The World Health Organization concluded that permethrin and its degradation products were unlikely to attain levels of environmental significance when recommended application rates were used.**

There is also no evidence of adverse effects on people when permethrin is used as recommended. The panel also noted that, although permethrin is highly toxic to fish, aquatic arthropods, and honey bees under laboratory conditions, lasting adverse effects are unlikely when the chemical is used as recommended in the field.<sup>59</sup> In addition, previously cited findings from the Minnesota Department of Health's risk assessment also apply to permethrin.

## **INSECTICIDES USED BY OTHER JURISDICTIONS**

We asked what insecticides were used in Minnesota cities outside the Twin Cities area and other states to control mosquitoes. As we discussed in Chapter 1, between 40 and 44 Minnesota cities provided mosquito control services in 1997 and 1998. Using information from the municipal pest control applications filed with the Department of Agriculture, we found that:

- **For adult mosquito control, most of the acres in outstate cities were treated with chlorpyrifos, a broad spectrum organophosphate. Permethrin was the next most used insecticide.**

These Minnesota cities treated about 42,000 acres with insecticides to control adult mosquitoes in 1997 and 1998. They used products containing chlorpyrifos to treat about 33 percent of these acres in 1997 and 40 percent in 1998.

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<sup>56</sup> National Pesticide Telecommunication Network, *Permethrin*.

<sup>57</sup> *Ibid.*

<sup>58</sup> 40 *Code of Federal Regulations* 180.378, revised July 1, 1997.

<sup>59</sup> World Health Organization, "Environmental Health Criteria 94-Permethrin," Geneva, 1990, 16-17. Published under the joint sponsorship of the United Nations Environment Programme, the International Labor Organisation, and WHO.

Permethrin was the second most commonly used insecticide accounting for 28 percent of the acres treated in 1997 and 21 percent in 1998.

Few cities in Minnesota outside of the Twin Cities area attempt to control mosquito larvae; these cities only treated about 5,000 acres in 1997 and 1998. Over 60 percent of larval control was done using methoprene, primarily pellets.

Generally, we found that:

- **While most states used the same insecticides as MMCD, some states also used other insecticides that can potentially cause more harm to the environment because they are less specific to mosquitoes.**

The most commonly used insecticides in the four state-operated mosquito control programs (Connecticut, Delaware, Kentucky, and Maryland) were *Bti*, methoprene, resmethrin, and permethrin.<sup>60</sup> In addition, each of these states used various organophosphates, such as chlorpyrifos, naled, temephos, and malathion. Organophosphates are non-systematic, broad-spectrum insecticides of the type that MMCD stopped using in the mid-1980s. Kentucky also used carbaryl (trade name Sevin), a broad-spectrum carbamate insecticide to control adult mosquitoes. Carbaryl can produce adverse effects in humans and animals and is lethal to many nontarget species.<sup>61</sup>

Insecticides used in six other states with large mosquito control operations included the same insecticides as MMCD currently uses, in addition to malathion (used in all but one of these states), naled (Dibrom), and chlorpyrifos.<sup>62</sup> Mosquito control districts in California also used propoxur (Baygon), which is a general use carbamate insecticide. Florida and North Carolina also used sumithrin, a synthetic pyrethroid which is commonly combined with PBO, to kill adult mosquitoes. A mosquito larvae insecticide commonly used in other states is temephos (Abate), which is a broader spectrum insecticide than *Bti* or methoprene.<sup>63</sup> Finally, some states also used natural pyrethrins and oils on the surface of water to control mosquito larvae.<sup>64</sup>

## ALTERNATIVES

*Lagenidium giganteum*, a fungus that attacks mosquito larvae, is a new insecticide that shows promise as an improvement over current larvicides. It is considered a biological insecticide. MMCD is testing Laginex, a commercial form of *Lagenidium giganteum*, as an alternative to methoprene to control cattail mosquito

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<sup>60</sup> The results of our telephone survey in other states are discussed in Chapter 5.

<sup>61</sup> EXTTOXNET, "Carbaryl," revised 6/96, 1.

<sup>62</sup> Program Evaluation Division telephone survey of other states, Summer 1998. These states include: California, Florida, Massachusetts, New Jersey, North Carolina, and Rhode Island.

<sup>63</sup> EXTTOXNET, "Temephos," revised 3/98. In addition to Delaware, Florida and New Jersey used temephos.

<sup>64</sup> Florida, California, and Rhode Island continue to oil some surface waters.

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**Laginex is a new larval insecticide being tested by the District.**

larvae.<sup>65</sup> Laginex is about half the cost of methoprene and may pose fewer risks to other insects. One limitation is that Laginex has a shelf life of only two weeks, requiring precise timing when ordering and applying the product. Unlike *Bti*, it can reproduce itself in the environment, so it has some potential for killing successive broods of mosquitoes.

Researchers have tested *Lagenidium giganteum*'s safety for a variety of organisms, including green plants, algae, nontarget insects, fish, crayfish, crustaceans, mallards, and quail.<sup>66</sup> One species of biting gnat was adversely affected. Based on laboratory tests, researchers have reported some possibly harmful effects to a few types of small water crustaceans and one type of midge at higher doses. The researchers stated, however, that their results cannot be generalized to natural systems where the fungus would be used for mosquito control.<sup>67</sup> Growth of the fungus is significantly restricted above 90 degrees (F), which precludes active infection of either birds or mammals because of their higher body temperatures. Intravenous tests in mice showed their ability to clear the fungus after 18 hours. Treated animals showed no abnormal behavior or appearance.<sup>68</sup>

As to the value of natural predators for mosquito control, we found that:

- **There is no scientific evidence that natural predators, such as bats and purple martins, can control mosquitoes to the degree demanded by people.**

Purple martins and bats consume relatively few mosquitoes.<sup>69</sup> Dietary studies have shown that mosquitoes are insignificant in the purple martin diet; studies of stomach contents of bats showed beetles as the dominant food.<sup>70</sup>

Another review of natural predators, including dragonflies, praying mantis, purple martins, and bats, concluded that these organisms have not significantly reduced mosquito populations in controlled experiments, particularly during mosquito

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65 Stephen Manweiler, Mark Smith, Scott Luberda, and Gary Hillsdale, "Laginex AS Test in a Minnesota Cattail Marsh, June-July 1997," unpublished, Metropolitan Mosquito Control District, nd.

66 James L. Kerwin, Deborah A. Dritz, and Robert K. Washino, "Nonmammalian Safety Tests for *Lagenidium giganteum* (Oomycetes: Lagenidiales)," *Journal of Economic Entomology* 81 (1988): 158-171.

67 Lori B. Nestrud and Richard L. Anderson, "Aquatic Safety of *Lagenidium giganteum*: Effects on Freshwater Fish and Invertebrates," *Journal of Invertebrate Pathology* 64 (1994): 228-233.

68 James L. Kerwin, Deborah A. Dritz, and Robert K. Washino, "Confirmation of the Safety of *Lagenidium giganteum* (Oomycetes: Lagenidiales) to Mammals," *Journal of Economic Entomology* 90 (1990): 374-376.

69 Mitchell Lee, "Myths About Mosquito Control (Bats, Birds and Bug Zappers)," *The Vector Control Bulletin of the North Central States* 2 (1993): 35-40; Gary L. Benzon, "Controlling Mosquitoes and Other Flying Insects Within Municipalities," *Public Works* (December 1988): 46-49.

70 William F. Lyon, Richard L. Berry, and Michael F. Collart, "Mosquitoes—Ohio State University Extension Factsheet," Department of Entomology, Columbus OH.



population peaks.<sup>71</sup> One reason is that mosquitoes are often found in habitats that are not suited to these generalist predators. Furthermore, the enormous production of nuisance mosquitoes following a rain can overwhelm predators.

In some parts of the country a fish called a mosquitofish, or *Gambusia*, is used to control mosquitoes. The fish can be put into ponds to eat mosquito larvae, but the fish also eats nontarget insects. The fish is found in southern Illinois and in the Mississippi River only as far north as central Iowa, which suggests that Minnesota maybe too far north for it to survive here.<sup>72</sup> If the fish were introduced in Minnesota, it might disrupt native species. DNR does not support introduction of this fish.<sup>73</sup>

## SUMMARY

In this chapter, we reviewed studies on the safety of the insecticides that MMCD uses for larval and adult mosquito control. We reviewed EPA documents, scientific research, and risk assessments.

Overall, we found little evidence that *Bti* or methoprene, which are used to kill mosquito larvae, pose a significant risk to the environment or to humans; the same applies to *Bti* when used against black fly larvae. Some species of midges may suffer decreases in population where these insecticides are used. Researchers have not detected significant adverse effects on other aquatic organisms, the reproduction of red-winged blackbirds, or the numbers of other bird species. We also reviewed current thinking on the possible relationship between deformed frogs and methoprene. To date, scientists have not been able to find a cause for the deformities. A by-product of methoprene's breakdown can cause deformities in the laboratory, but there is no credible evidence that this actually happens in the field.

As to the insecticides used against adult mosquitoes, the Environmental Protection Agency, the World Health Organization, and the Minnesota Department of Health have found that resmethrin and permethrin should not pose hazards to the public when applied in the prescribed manner. However, permethrin and resmethrin are broader spectrum insecticides and permethrin and piperonyl butoxide, an active ingredient in resmethrin, are possible human carcinogens. Therefore, these products must be applied judiciously and in strict conformity with EPA label requirements.

We also reviewed the use of alternatives to control mosquitoes. Natural predators against mosquitoes, such as bats and purple martins, have not been effective at controlling mosquitoes to the degree that people want.

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71 Illinois Department of Public Health, "Mosquitoes in Illinois—Recommendations for Prevention and Control," 1995: 4.

72 <<http://www.state.ia.us/fish/iafish/miscfam/mosquito.htm>>.

73 Minnesota Environmental Quality Board, Mosquito Control Technical Work Group, "Final Report," April 12, 1994: Appendix D.

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# Mosquito Control Activities

## CHAPTER 3

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The activities of the Metropolitan Mosquito Control District (MMCD) involve monitoring mosquito and black fly larval and adult populations, and applying insecticides to kill these insects in the Twin Cities area. In this chapter we review the District's mosquito and black fly control activities. We examine the number of acres treated with insecticides and procedures used to determine if treatments are needed. We asked the following questions:

- **How has the Metropolitan Mosquito Control District's use of insecticides for mosquito larvae and adult control changed since 1995?**
- **Does the District follow its own policies and procedures in deciding when to apply insecticides to control mosquitoes and black flies?**
- **How has the District managed requests from property owners who refuse the District access to their property?**

To address these issues we reviewed MMCD's policies and procedures, made site visits and observed operations in the field, analyzed the District's treatment databases, and interviewed staff from the District and other public agencies, as well as staff from cities in the Twin Cities area.

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**The  
Metropolitan  
Mosquito  
Control District  
treated  
15 percent  
fewer acres in  
1998 than in  
1997.**

The District treated almost 197,500 acres with insecticides in 1998, a 15 percent reduction from 1997. Mosquito larval breeding acres represented about 64 percent of all acres treated in 1998. Of the insecticides used by MMCD, the District used the least costly insecticides for most of its treatments. *Bti* accounted for most (90 percent) of the acres treated to kill mosquito larvae, while resmethrin accounted for most (91 percent) of the acres treated to kill adult mosquitoes in 1998.

We found that in nearly all cases the District applied insecticides when treatment thresholds indicated that treatments were warranted, staff from the Department of Health think the District plays a valuable role in the prevention of mosquito-borne diseases, and the District usually has applied insecticides according to label directions and in compliance with state regulations. However, we also identified concerns with the District's adult and refused treatment policies and practices, and management of its treatment data.

## MOSQUITO CONTROL ACTIVITIES

**The District says its primary focus is to kill mosquito larvae.**

MMCD claims that the primary focus of its mosquito control activities is to kill mosquito larvae, with localized adult mosquito control to prevent disease transmission and to reduce mosquito annoyance in public parks and at public events. We examined the District's treatment data to determine if the District focuses on killing mosquito larvae. Table 3.1 summarizes the acres treated by MMCD with insecticides from 1995 to 1998. The District treated almost 197,500

**Table 3.1: Acres Treated by MMCD with Larval and Adult Insecticides, 1995-98**

<u>Mosquito Larvae Control</u>	<u>1995<sup>a</sup></u>	<u>1996<sup>a</sup></u>	<u>1997<sup>b</sup></u>	<u>1998<sup>c</sup></u>
Methoprene briquets (150-day timed-release)	7,303	421	501	371
Methoprene briquets (90-day timed-release)	0	0	0	961
Methoprene pellets	8,212	10,654	8,851	10,432
Methoprene liquid	668	565	1,645	425
<i>Bti</i> granules	<u>131,589</u>	<u>68,355</u>	<u>106,755</u>	<u>113,538</u>
Total	147,772	79,996	117,752	125,727
<u>Mosquito Adult Control</u>				
Permethrin	6,305	5,914	7,035	6,175
Resmethrin	<u>61,858</u>	<u>120,472</u>	<u>106,441</u>	<u>65,586</u>
Total	68,163	126,387	113,476	71,761
Grand Total	215,935	206,383	231,228	197,488
<u>Black Fly Control</u>				
<i>Bti</i> liquid (in gallons)	3,606	3,025	5,445	4,032

NOTES: Treatments with Laginex liquid and sand-based materials used in Wright County research and in regional offices on an experimental basis are not reflected. Numbers may not sum due to rounding.

<sup>a</sup>The 1995 and 1996 acres are based on Metropolitan Mosquito Control District computer treatment records.

<sup>b</sup>The 1997 acres are estimated using the Metropolitan Mosquito Control District's audited inventory records. Estimates are based on assumptions regarding the use of materials at different application rates.

<sup>c</sup>The 1998 acres are based on Metropolitan Mosquito Control District computer treatment records through mid-September. The figure for *Bti* liquid (in gallons) used for 1998 is from the District's inventory records for 1998 through September 12, 1998.

SOURCES: Metropolitan Mosquito Control District treatment data for 1995, 1996, and 1998; Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, Consumable Inventory Work Papers Folder 5.

**Treatment of mosquito breeding acres represented 64 percent of all acres treated in 1998.**

acres in 1998, a 15 percent reduction from 1997 and a 4 percent reduction from 1996. The data also show that:

- **Except for 1996, the MMCD has treated more acres to kill mosquito larvae than to kill adult mosquitoes.**

The District's treatment of mosquito larval breeding acres represented 68 percent of all acres treated in 1995 and 64 percent of all acres treated in 1998. In 1996, however, the District dramatically increased the number of acres treated with insecticides to kill adult mosquitoes. The District treated nearly 46 percent fewer mosquito larval breeding acres (from 147,772 to 79,996 acres) and 85 percent more acres to control adult mosquitoes (from 68,163 to 126,387 acres) in 1996 than it did in 1995. Since 1996, the District has increased the number of breeding acres treated and decreased the number of acres treated to kill adult mosquitoes. By 1998 MMCD treated about 57 percent more breeding acres than in 1996 and about 43 percent fewer acres for adult control than in 1996.

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**Acreage treated with insecticides to kill adult mosquitoes increased 85 percent from 1995 to 1996.**

In addition to being affected by a reduced budget in 1996, changes in acres treated were related to the rainfall for the time period examined. Generally, 1996 was a drier than normal summer, while 1997 was wetter than normal. The average rainfall in 1996 was 31 percent lower than the 38-year average for the Twin Cities area. This below normal rainfall resulted in only 6 broods of mosquitoes during the summer of 1996 compared with an average of 9 to 12 broods per year.<sup>1</sup> Average rainfall in 1997 was 9 percent higher than the 39-year district average and produced 9 broods of mosquitoes.<sup>2</sup> District staff have told us that weather conditions were the primary reason for the reduction in acres treated for adult mosquito control in 1998. There was no purposeful intent on the District's part to reduce acres treated for adult control.

Our review of MMCD's treatment and inventory records found that:

- ***Bti* granules accounted for 9 out of 10 acres treated to kill mosquito larvae, while resmethrin accounted for 9 out of 10 acres treated to kill adult mosquitoes between 1995 and 1998.**

Table 3.2 shows the total cost and cost per acre for insecticides used by MMCD to kill mosquito larvae and adults in 1997. These data show that:

- **The predominant insecticides used by MMCD, namely *Bti* and resmethrin, were the least costly per acre treated. But larval insecticides, which are more expensive per acre than adult insecticides, accounted for over 91 percent of insecticide costs in 1997.**

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<sup>1</sup> Metropolitan Mosquito Control District, *1996 Operational Review and Plans for 1997*, March 1997: 25, 34.

<sup>2</sup> Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*: 24-25.

The annual costs of the helicopter contract (\$827,900 in 1997) can also be added to the costs of larval control. In addition, District staff estimate that about 90 percent of the truck fleet supports larval control activities. District staff are involved with larval control activities for about eight months and adult control activities for three months of the year. Control operations staff salaries and wages

**Table 3.2: Costs of Mosquito Control Insecticides, 1997**

<u>Larval Control Materials:</u>	<u>Application Rate</u>	<u>Cost per Acre</u>	<u>Total Costs</u>
150-day methoprene briquets - floodwater mosquitoes <sup>a</sup>	220 per acre	\$388.73	\$ 215,742
cattail mosquitoes	330 per acre	583.10	
cattail mosquitoes	440 per acre	777.46	
30-day methoprene pellets - floodwater mosquitoes	2.5 lbs. per acre	52.90	526,247
cattail mosquitoes	4.0 lbs. per acre	84.64	
Methoprene liquid	1 oz. per acre	5.71	12,675
<i>Bti</i> granules - bulk	5 lbs. per acre	4.82	48,253
	8 lbs. per acre	7.71	
<i>Bti</i> granules - bags	5 lbs. per acre	5.29	800,336
	8 lbs. per acre	8.47	
<i>Bti</i> liquid	6 oz. per acre	0.92	101,479
<u>Adult Control Materials:</u>			
Permethrin	25 oz. per acre	7.68	54,039 <sup>b</sup>
Resmethrin - hand-held machine	2.5 oz. per acre	1.66	107,895
cold fogger	1.5 oz. per acre	1.00	
Total for adult control			161,934
Total for larval control			<u>1,704,732</u>
Grand Total			\$1,866,666
Share of costs for adult control			8.7%
Share of costs for larval control			91.3%

<sup>a</sup>Represents 1996 price for briquets of \$388.73 per case. MMCD purchased briquets for both 1996 and 1997 in 1996. Price of briquets in 1998 was \$441.14 per case.

<sup>b</sup>The cost of mineral/soybean oil used to dilute the concentrated permethrin mixture is included in the total cost. The cost per acre is based on the diluted mixture.

SOURCE: Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, Consumable Inventory Work Papers Folder 5, N11.

**The predominant insecticides used by MMCD, *Bti* and methoprene, were also the least costly per acre treated in 1997.**

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**Since 1995, the District has reduced its use of methoprene briquets, the most expensive larval control product.**

totaled over \$3 million in 1997, but the District does not use detailed cost codes to account for employees' time. Therefore, we were unable to estimate what proportion of the District's total budget is dedicated to larval versus adult control activities.

Table 3.1 also shows how MMCD's use of insecticides changed in 1996 as a result of the budget reduction. Instead of using 150-day timed-release methoprene briquets, the most expensive larval control material, for small hand-treated sites, the District used methoprene pellets and, to a lesser extent, *Bti* granules. Acres treated with methoprene briquets decreased 94 percent between 1995 and 1996 (from 7,303 to 421 acres).<sup>3</sup> At the same time, the acres treated with methoprene pellets increased nearly 30 percent. MMCD made this decision based in part on the higher cost of the briquets and concerns about their effectiveness.<sup>4</sup> The acres treated with *Bti* granules declined in 1996, most likely because of drier than normal conditions, and have increased each year since then.

## Larval Control Activity

The District's mosquito control services target the most productive mosquito breeding locations for human-biting mosquitoes. Since its formation in 1958, the District has identified and mapped over 65,000 potential and known larval breeding sites. District staff record the number and kind of larvae found and treatment information for every site on section cards. The District updates section maps annually to reflect changes in breeding sites.

We examined where the District has focused its larval control efforts between 1995 and 1998. Figure 3.1 shows the number of breeding acres treated by priority area by year.<sup>5</sup> In 1995, before MMCD's budget cut, the District treated 143,314 breeding acres, 63 percent of which were in Priority Area 1, 28 percent were in Priority Area 2, and 9 percent were in Priority Area 3.<sup>6</sup> With the reduction in its 1996 budget, the District treated fewer acres with larval insecticides in all priority areas and concentrated its larval control efforts in Priority Area 1. In 1996, the District treated 75,033 acres with larval insecticides, 77 percent of which were in Priority Area 1 and 22 percent of which were in Priority Area 2.

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<sup>3</sup> In addition to reducing its use of briquets, the District has changed how the briquets were used. In 1995, approximately 93 percent of the 7,303 acres treated with briquets were floodwater mosquito breeding sites and 7 percent were cattail mosquito breeding sites. In 1998, cattail mosquito breeding sites accounted for about 67 percent of the 371 acres treated with 150-day, timed-release briquets.

<sup>4</sup> Metropolitan Mosquito Control District, *1996 Operational Review*: 21. The efficacy of control materials is discussed in Chapter 4.

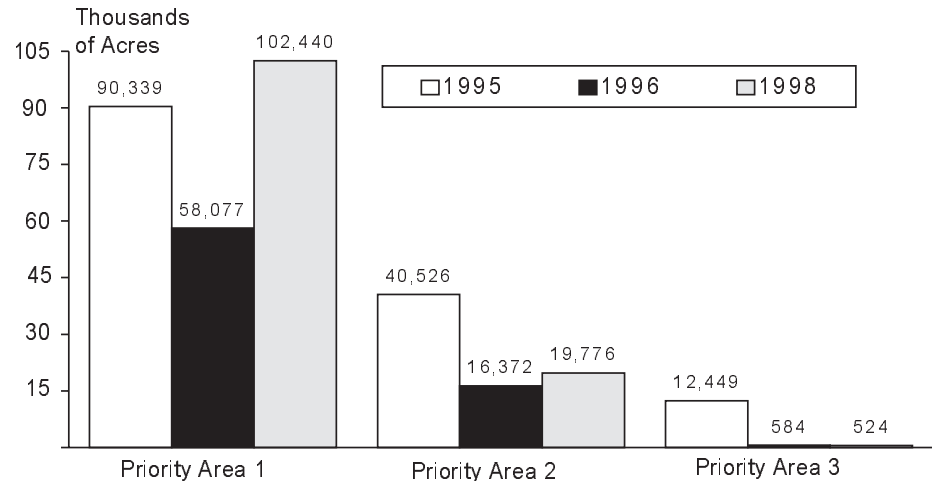
<sup>5</sup> We used 1997 priority areas in this analysis because when MMCD updates its master breeding site data it does not retain priority area data for prior years. Consequently, our analysis reflects the number of 1997 priority area acres that were treated in 1995 and 1996. In 1995, the District used two priority areas. In 1996, the District added Priority Area 3 and Priority Area 1 and 2 "satellites," which include population centers located in Priority Areas 2 and 3 such as Jordan, Hastings, Forest Lake, Rogers, Randolph, and Hampton. In 1997 and 1998, the District modified but did not significantly change the priority areas.

<sup>6</sup> The priority areas were not identified in treatment databases for between 3 and 6 percent of the acres treated in each year. Therefore, data on acres treated by priority area do not correspond with total acres treated.



**In 1998,  
83 percent of  
the mosquito  
breeding acres  
treated were in  
Priority Area 1.**

**Figure 3.1: Breeding Acres Treated by Priority Area, 1995-96, 1998**



NOTE: Analysis does not include 1997 data because of concerns about data quality.

SOURCE: Program Evaluation Division analysis of Metropolitan Mosquito Control District treatment data.

The Metropolitan Mosquito Control Commission approved a 1997 budget for the District that was 7 percent higher than the 1996 budget, and the District predicted that the 1997 budget would allow it to “recover some of the services lost in 1996.”<sup>7</sup> With an 11 percent increase in its commission-approved 1998 budget, MMCD planned to hire additional seasonal inspectors, increase helicopter services, and purchase more insecticides. In 1998, the District planned to “significantly” increase service to Priority Area 1 and to increase service to Priority Area 2 “to a lesser extent.”<sup>8</sup> Our analysis shows that:

- **The District expanded treatment of mosquito breeding acres primarily in Priority Area 1 between 1996 and 1998.**

In 1998, the District treated 76 percent more Priority Area 1 acres than in 1996.<sup>9</sup> By 1998, the number of acres treated in Priority Area 1 exceeded the 1995 figure and accounted for 83 percent of the acres treated (102,440 of 122,740 acres treated). In Priority Area 2, the District treated 19,776 acres in 1998, 21 percent more than in 1996, but still 51 percent fewer than in 1995. In 1998, 16 percent of the acres treated were in Priority Area 2. The District treated even fewer acres in Priority Area 3 in 1998 than in 1996; by 1998, the District was treating 524 Priority Area 3 acres.

<sup>7</sup> Metropolitan Mosquito Control District, *1997 Budget*, January 6, 1997: ii.

<sup>8</sup> Metropolitan Mosquito Control District, *1998 Budget*: 9, 13.

<sup>9</sup> Our analysis does not include the District’s 1997 treatment data because of concern about the quality of the data, which is discussed later in this chapter.

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**We examined whether the District used its established treatment thresholds before applying insecticides.**

MMCD has established thresholds for the number of mosquito larvae that must be present before it will treat sites. The treatment thresholds vary by type of mosquito and priority area. For example, the treatment threshold for floodwater mosquito breeding sites treated with a helicopter is an average of two larvae per dip in Priority Area 1.<sup>10</sup> Breeding sites treated by District staff on the ground require only a presence of mosquito larvae before treatment. In some instances, these sites consist of shallow depressions, tire ruts, and similar features. Staff focus ground treatments on sites with a history of producing larvae.

Breeding sites treated by helicopter accounted for 89 to 92 percent of the acres treated by MMCD with larval insecticides in 1995, 1996, and 1998. Our analysis focused on 1998 breeding sites treated by helicopter to determine if the District treated sites that met its thresholds.<sup>11</sup> We found that:

- **Nearly all of the mosquito breeding sites treated by helicopter in 1998 met the treatment thresholds.**

Of the 5,083 breeding site treatments made by helicopter in 1998, the District treated 95 percent of the sites after a pretreatment count established that the threshold had been met. The District labeled 60 percent of the 254 treatments that did not meet pretreatment thresholds “FAST” (First Air Sites Treated) sites, or sites that were treated because of a history of breeding mosquitoes rather than pretreatment counts.<sup>12</sup>

## Adult Control Activity

The use of insecticides to kill adult mosquitoes has been the focus of recent criticism of MMCD. In this section we examine changes in how and where adult insecticides were applied, the District’s adult mosquito treatment policy, reasons for adult treatments, and use of treatment thresholds.

The increased use of insecticides to kill adult mosquitoes was a significant change in MMCD control efforts following the 1996 budget cut. According to the District, it increased adult control to provide service in areas not receiving larval control. At a November 1995 Technical Advisory Board (TAB) meeting, some board members expressed concern about this strategy before it was implemented. The TAB then passed resolutions recommending that “the District continue to

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<sup>10</sup> The treatment threshold for floodwater mosquitoes in Priority Area 2 is an average of 5 per dip. For spring *Aedes* the thresholds are 0.1 and 0.5 in Priority Areas 1 and 2, respectively. To determine pretreatment larvae counts for sites treated by air, MMCD field staff lower a dipper into the water at several locations in a breeding site to collect a sample of larvae. Staff determine an average number of larvae per dip and send the sample to the District’s laboratory, which identifies the species and stage of larval development. If the laboratory analysis confirms that a sample consists of larvae of human-biting mosquitoes that are still feeding and meet the threshold, field staff are given the “green light” to treat the site.

<sup>11</sup> Our analysis did not include acres treated with sand-based insecticides or Lagenex liquid.

<sup>12</sup> Other treated sites not meeting pretreatment thresholds included: 40 sites that were close to Priority Area 1 and treatment provided protection to Priority Area 1 residents; 28 sites where staff used “professional judgment” to determine that treatment was needed; and 30 cattail mosquito breeding sites. MMCD staff told us that 0.25 larvae per dip threshold for cattail mosquitoes is a guide; treatments will be done if a site has a history of breeding cattail mosquitoes.

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**The District reduced the number of acres treated to kill adult mosquitoes in 1998 because weather conditions did not produce large mosquito populations.**

emphasize larval control” and “not necessarily respond to increased mosquito annoyance with an increase in adulticide use.”<sup>13</sup> At a spring 1997 TAB meeting, after members saw the actual increase in acres treated for adult control, they again expressed concern and recommended that the District focus primarily on control of mosquito larvae.<sup>14</sup> This concern continued into 1998 when the TAB cautioned against increasing the use of adult control insecticides as an automatic response to citizens’ requests for mosquito control services.<sup>15</sup>

The District decreased the number of acres treated to kill adult mosquitoes from about 113,500 acres in 1997 to about 71,800 acres in 1998, primarily because weather conditions did not produce significant infestations of adult mosquitoes. We used 1996 and 1998 treatment data to examine changes in how and where adult insecticides were applied.<sup>16</sup> Table 3.3 summarizes the acres treated by method of application and by regional office. The data show that:

- **The reduction in acres treated with resmethrin using a truck-mounted cold fogger accounted for most of the change in acres treated to kill adult mosquitoes between 1996 and 1998.**

Changes in the use of other insecticides and application methods were relatively small. In 1998, the Anoka and Jordan regional offices each accounted for about one-fourth of the acres treated for adult mosquitoes, while the Oakdale office accounted for less than one-fifth of all acres treated. Each regional office treated at least 44 percent fewer acres for adult mosquito control between 1996 and 1998, with the exception of the Jordan office, which treated 67 percent more acres.

### **Adult Mosquito Treatment Policy**

The District emphasizes that it provides limited localized adult mosquito control for highly frequented public parks and civic functions and in potential disease situations. The District’s current (revised June 1, 1998) adult mosquito treatment policy also includes citizen requests in its treatment protocol. The policy states:

The MMCD treats functions open to the public, and public owned park and recreation areas . . . upon request and at no charge if the event is not for profit. Public events operated for profit will not be treated. The District will also respond to citizen requests and will treat adult mosquitoes in a potential disease situation.<sup>17</sup>

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<sup>13</sup> Metropolitan Mosquito Control District, Technical Advisory Board Meeting Minutes, November 30, 1995: 3.

<sup>14</sup> Metropolitan Mosquito Control District, Technical Advisory Board Meeting Minutes, April 3, 1997: 2.

<sup>15</sup> Mr. Laurence N. Gillett, chair of the Technical Advisory Board, to Ms. Margaret Langfeld, chair of the Metropolitan Mosquito Control Commission, April 14, 1998, letter.

<sup>16</sup> MMCD applies permethrin during the day to perimeter vegetation of mosquito harborage areas using backpack sprayers carried by staff or mounted on all-terrain vehicles. It applies resmethrin using hand-held ULV sprayers for daytime applications when preferred vegetation is missing and ATV- and truck-mounted cold foggers at dusk or dawn.

<sup>17</sup> Metropolitan Mosquito Control District, Adult Mosquito Treatments, *Administrative Manual*, June 1, 1998: 1.

**Table 3.3: Acres Treated to Kill Adult Mosquitoes, 1996 and 1998**

<u>By Method of Application</u>	<u>1996</u>	<u>1998</u>	<u>Percent Change</u>
Permethrin			
Staff-carried backpack	2,113	3,661	73.3%
ATV-mounted backpack	3,907	2,503	-35.9
Resmethrin			
Hand-held ULV	1,681	1,448	-13.9
ATV fogger	10,485	11,645	11.1
Truck-mounted cold fogger	<u>108,054</u>	<u>52,263</u>	-51.6
Total	126,240 <sup>a</sup>	71,520 <sup>b</sup>	-43.3
<u>By Region</u>	<u>1996</u>	<u>1998</u>	<u>Percent Change</u>
North Region - Anoka	32,207	17,980	-44.2%
South Region - Jordan	11,773	19,614	66.6
South Region - Rosemount	5,533	2,951	-46.7
West Region - Maple Grove	23,510	9,955	-57.7
West Region - Plymouth	24,737	9,616	-61.1
East Region - Oakdale	<u>28,626</u>	<u>11,645</u>	-59.3
Total	126,387	71,761	-43.2

NOTE: Numbers may not sum due to rounding.

<sup>a</sup>Information on the method of application was missing for 147 acres in 1996.

<sup>b</sup>Information on the method of application was missing for 242 acres in 1998.

SOURCE: Program Evaluation Division analysis of Metropolitan Mosquito Control District treatment data.

**Acres treated with resmethrin using a cold fogger accounted for most of the acres treated to kill adult mosquitoes in 1996 and 1998.**

The policy discusses a number of ways that treatment may be initiated. Parks and recreation directors may schedule season-long treatment for a particular park with one request to the District or they and community event organizers may make requests a minimum of seven days before a special event. Citizens or neighborhoods of citizens, along with public officials, may request treatments for functions or for “perceived annoyance.” MMCD team leaders may initiate treatments if they become aware of high adult mosquito counts in populated areas and confirm these high adult mosquito counts through sweep net or other collections. MMCD-initiated treatments must be cleared by the District’s director or group leaders. Finally, treatments may be initiated in response to health concerns such as LaCrosse encephalitis.<sup>18</sup>

<sup>18</sup> *Ibid.*

Examples of areas that may be treated for adult mosquitoes are listed in the policy. Although not intended to be inclusive “if they are not for profit,” the examples include: park and recreation areas, school events (such as graduation and athletic events), public events (such as county fairs and Fourth of July celebrations), city- or county-owed golf courses, and youth camps (such as boy scout, girl scout, and church camps). The District may treat LaCrosse encephalitis sites where at least two adult tree hole mosquitoes have been found and borders of areas not receiving larval control.<sup>19</sup> The policy states that District staff are supposed to inform callers that there are private companies that can do adult mosquito control on their property or for a private function.

District staff revised the adult mosquito treatment policy and procedures in 1998, the first revision since 1994. Most of the changes involved clarifying or updating language to reflect the current District organization, product labels, and application methods. After comparing the current policy with past priorities, reviewing treatment practices, and interviewing District staff, we concluded that:

- **The District’s current adult mosquito treatment policy and practices give more emphasis to responding to citizen requests than did earlier adult treatment priorities.**

In 1993, the District set priority categories for adult mosquito control (see Figure 3.2).<sup>20</sup> For evening cold fog treatments with resmethrin, the highest priority treatments were for potential disease carrying mosquitoes, public park and recreation areas, school events, and public golf courses. Neighborhood treatments and treatment of mosquito harborages not associated with parks were Category 3 priorities in 1993. For backpack treatments with permethrin, no reference was made to citizen requests or neighborhood treatments.

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**Contrary to its policy, the District provided adult mosquito treatments for some for-profit enterprises and private functions in 1998.**

While the current policy does not overly emphasize providing service to citizens, MMCD staff told us that early in the 1998 mosquito season, the District director visited regional offices and emphasized to staff the need to respond to citizen requests and provide customer service. During our site visits we noted that adult treatments in some regions focused on daytime spraying of harborage areas (stands of trees and shrubs) on individual private properties. We found that:

- **It appears that the Metropolitan Mosquito Control District does not follow its 1998 adult mosquito treatment policy.**

We found some instances of the District providing adult treatments to for-profit enterprises, such as drive-ins, entertainment venues, and raceways. District staff told us that these treatments were justified either because the venues were frequented by area citizens or because the treatment would provide protection to residents living near the treated harborage area. We also found instances of the District providing adult treatments for private functions either in public parks or at private residences, such as graduation parties and wedding receptions.

<sup>19</sup> The District’s adult treatment policy also contains sections on requests for no treatment, which are discussed later in this chapter, and notification procedures, which are discussed in Chapter 5.

<sup>20</sup> Metropolitan Mosquito Control District, *Annual Operations Report, 1993*, July 1993: 20-22.

**Figure 3.2: MMCD 1993 Adult Mosquito Treatment Priorities**

**Cold Fogging - Resmethrin**

<u>Category</u>	<u>Description</u>	<u>Priorities</u>
1	Areas treated on request	<ul style="list-style-type: none"> <li>• MMCD initiated for areas with high levels of potential disease carrying mosquitoes</li> <li>• Public park and recreation areas</li> <li>• School events</li> <li>• Publicly-owned golf courses</li> </ul>
2	Reviewed by MMCD staff before treatment	<ul style="list-style-type: none"> <li>• Charity events</li> <li>• Community service groups, clubs and organizations whose function is open to the public (such as service clubs, churches)</li> <li>• Privately-owned golf courses hosting special events open to the public (such as celebrity golf tournaments for a charity group)</li> <li>• Business/corporate functions open to the public and free or charity fund raisers</li> </ul>
3	Directive from MMCD staff or director	<ul style="list-style-type: none"> <li>• Neighborhood treatments</li> <li>• Harborage treatments not associated with park and recreational areas or events</li> <li>• Areas not routinely treated in the past</li> </ul>

**Backpack Treatments - Permethrin**

<u>Category</u>	<u>Description</u>	<u>Priorities</u>
1	Regular or scheduled treatments	<ul style="list-style-type: none"> <li>• Public park and recreation areas</li> </ul>
2	Areas treated on request	<ul style="list-style-type: none"> <li>• MMCD initiated for areas with high levels of potential disease carrying mosquitoes</li> <li>• Community sponsored events or functions (such as county fairs)</li> <li>• School events</li> <li>• Publicly-owned golf courses</li> </ul>
3	Reviewed by MMCD staff before treatment	<ul style="list-style-type: none"> <li>• Charity events</li> <li>• Community service groups, clubs and organizations whose function is open to the public (such as celebrity golf tournaments for a charity group)</li> <li>• Business/corporate functions open to the public and free or charity fund raisers</li> </ul>

SOURCE: Metropolitan Mosquito Control District, *Annual Operations Report, 1993*, July 1993: 20-22.



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## **The District needs to review its policy for providing adult mosquito treatments to for-profit enterprises.**

In a discussion with District staff late in our evaluation, we were told that the District provides adult mosquito treatments to for-profit enterprises, such as restaurants and privately-owned golf courses, based on a discussion that took place at a May 22, 1996 executive committee meeting. At that meeting, staff noted that since for-profit properties pay taxes, they should receive a basic level of service, perhaps for a fee. However, the minutes from that meeting show that the executive committee did not take any formal action on this issue. Instead, committee members directed staff to look into the possibility of having for-profit enterprises pay for the cost of the insecticide and let these customers know that the District was planning to change its adult treatment policy. Our review of meeting minutes indicates that the full Commission did not review or approve a change in adult treatment policy based on the May 1996 executive committee discussion. Indeed, provisions for treating for-profit enterprises were not incorporated into the District's adult treatment policy when it was revised in June 1998. Finally, District staff had difficulty articulating the District's adult mosquito treatment policy. It was not clear whether the District does not treat for-profits, treats for-profits for a fee, or treats for-profits at no charge. We recommend that:

- **The Metropolitan Mosquito Control Commission should review the District's existing policies and procedures and adopt a comprehensive, well articulated adult mosquito treatment policy.**

Further, we recommend that:

- **The Metropolitan Mosquito Control District should reexamine its adult treatment procedures to ensure that practices conform with its current adult treatment policy.**

The District's 1998 adult treatment policy clearly states that it will provide mosquito control services for "not for profit" events and people requesting mosquito control services for their property for a private function will be referred to private companies that do mosquito control. In addition to clarifying its adult mosquito treatment policy, the District may also want to review its treatment procedures to ensure that the practices conform with its current policy.

### **Reasons for Adult Treatments**

We used MMCD's treatment data to try to determine the reasons for adult mosquito treatments. We found that:

- **Our ability to analyze and make definitive conclusions about the reasons for adult mosquito treatments was limited because of problems with the data.**

**Customer requests, parks, and events were the reasons for most of the acres treated for adult mosquitoes in 1998.**

In 1995, the District identified three possible “causes” for adult treatments: park, event, or other.<sup>21</sup> We were unable to identify a specific cause for 45 percent of the acres treated because about 27 percent of the acres were missing a cause code and another 18 percent were coded as “other.”<sup>22</sup>

Starting in 1996, the District expanded the possible reasons for adult treatments to six options: customer response, park, event, LaCrosse encephalitis, Western Equine encephalitis (*Culex tarsalis*), and other. Table 3.4 shows that the primary reasons for adult treatments were customer responses, parks, and events in 1996 and 1998.<sup>23</sup> In 1998 about 17 percent of the acres treated were coded as “other” or were missing a code. The percent of acres coded as “other” was quite high in some facilities. Similar concerns are evident in the 1996 data. This makes it difficult for us to make year-to-year comparisons with confidence. In addition, the wide range in the use of different codes among regional offices suggests that staff may not consistently code the reason for adult mosquito treatments. It is unclear how or whether staff made distinctions among park, event, or customer response treatments. A customer request for a treatment at a function in a park could be coded as “park,” “customer response,” or “event.” We recommend that:

- **MMCD should improve and clarify criteria and instructions on how to code the reason for an adult mosquito treatment to improve the consistency of the data collected by staff in the regional offices.**

**Table 3.4: Percentage of Acres Treated for Adult Mosquitoes by Reason, 1996 and 1998**

Reason for Treatment	1996		1998	
	District-wide Average	Range for Regions	District-wide Average	Range for Regions
Customer response	40%	6-63%	35%	17-60%
Park	36	16-54	27	4-42
Event	12	2-37	19	5-32
LaCrosse encephalitis	1	0-2	2	0-10
Western Equine encephalitis	1	0-3	0	N/A
Other	9	4-27	16	3-39
Missing data	2	0-4	1	0-2

SOURCE: Program Evaluation Division analysis of Metropolitan Mosquito Control District treatment data.

<sup>21</sup> The District uses a field form to record information on adult treatments. This form contains options for the “cause” of a treatment. On the 1995 field form the park and event options were shown as one option—park/event. Staff filling out the form were supposed to specify a “p” or an “e.” This may have led to some inaccurate coding.

<sup>22</sup> The percentage of 1995 adult control treatments missing a cause code or coded as “other” varied by region. For instance, in one region 44 percent of the records were missing a “cause” code. Another region coded 39 percent of its treatments as “other.”

<sup>23</sup> Analysis did not include 1997 data because of concerns about data quality. Analysis of 1998 adult treatment data included treatments through the middle of September.

Ideally, if MMCD does an adult mosquito treatment in response to a citizen request for treatment in a public park where an event will be held, then all regions should record the same reason for the treatment. We believe the reason for treatment is important information and, if used consistently, could reflect shifts in MMCD policy regarding customer responsiveness or treating for events. This information would also enable MMCD to respond to requests for information about why it is applying adult insecticides.

Though flawed, the adult treatment data suggested that:

- **Adult mosquito treatments done for reasons related to disease prevention accounted for fewer than 3 percent of the District’s adult mosquito treatments.**

When a reported case of LaCrosse encephalitis (LAC) occurs, one element of the District’s response is to spray for disease carrying adult mosquitoes in the vicinity of the case. The District also continues to monitor and treat past sites of reported LAC cases as needed. In 1996 and 1998, the reasons “LaCrosse encephalitis” and “Western Equine encephalitis” combined accounted for a small proportion of all adult treatments. In some regions, such as southern Hennepin County and Rosemount, these treatments were more prevalent than in other regions.

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**The amount of resmethrin applied by township in 1998 varied from 0 to 67 gallons.**

We also tried to determine where MMCD has applied insecticides to kill adult mosquitoes and how many times individual parks were treated. Unlike larval breeding sites, the District does not use unique site codes for adult mosquito harborage sites.<sup>24</sup> Therefore, it was not possible to analyze the number of times a specific park was treated or the number of acres that represent repeat treatments in the same location. Figure 3.3 shows where resmethrin was applied in 1998 and illustrates that more resmethrin was applied in certain townships in Anoka, Hennepin, and Scott county than other areas.

### **Treatment Thresholds**

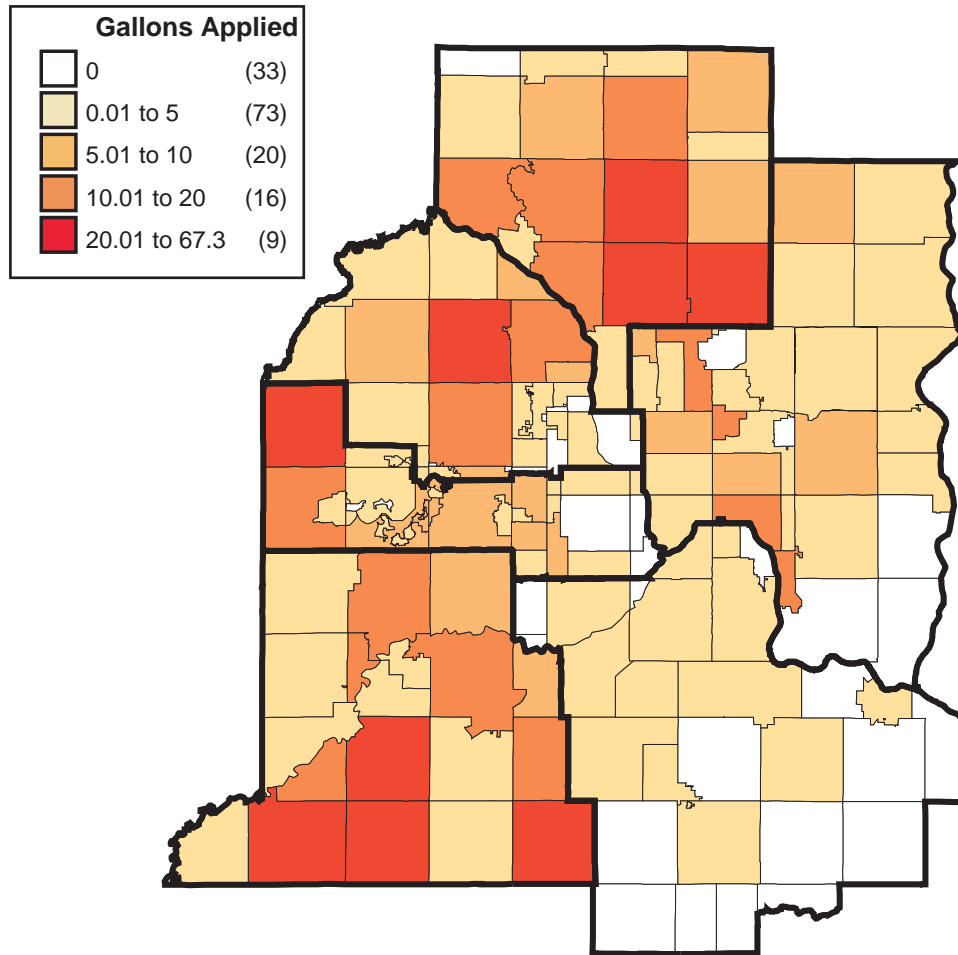
MMCD has a policy of killing adult mosquitoes with insecticides only after a pretreatment mosquito count in the area meets or exceeds an established threshold. District staff emphasized to us that the District makes it a practice to determine that threshold levels of mosquitoes are present before adult insecticides are applied. We focused on the District’s 1998 adult treatment file to determine if the District is meeting thresholds before treating an area with adult insecticides. MMCD takes adult pretreatment counts in one of four ways: a CO<sub>2</sub> trap, a sucomatic, a sweep net count, or a slap count.<sup>25</sup> A CO<sub>2</sub> trap left up overnight must collect over 130 mosquitoes for the threshold to be met. The District uses

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<sup>24</sup> Some regional offices use site codes for individual parks. However, for a large park the site code does not provide information on what sections of the park were treated. It should also be noted that District staff use treatment forms and maps to record all adult insecticide treatments. The forms and maps, which identify treatment locations, are maintained in paper files.

<sup>25</sup> CO<sub>2</sub> traps use dry ice to attract mosquitoes. Sucomatics are like large vacuums; as field staff walk through harborage areas to stir up the resting mosquitoes, the sucomatic draws them into a net. For a sweep net collection, a person stands in one spot and sweeps a net to capture mosquitoes. Field staff do slap counts by standing in a location and counting mosquitoes that land on them.

**Figure 3.3: Application of Resmethrin by Township, 1998**



NOTE: The amount of resmethrin used by the Oakdale facility according to its treatment records was over 15 percent higher than the use according to the inventory. Therefore, townships in Ramsey and Washington counties may reflect higher resmethrin use than actually occurred.

SOURCE: Metropolitan Mosquito Control District.

sucomatics to take counts of tree hole mosquitoes, the primary carrier for LaCrosse encephalitis. The threshold for sucomatic samples is two mosquitoes per five-minute collection. Thresholds for sweep net and slap counts are two mosquitoes in two minutes or five mosquitoes in five minutes.

Based on our analysis of adult treatment data, we found that:

- **With few exceptions, the District provided adult treatments in 1998 only after pretreatment thresholds had been met.**

There were 4,003 treatment records in MMCD's 1998 adult treatment file. Of the 3,763 treatments that we were able to analyze, the District met the established threshold before treatment in 99.5 percent of the treatments.<sup>26</sup>

## Insect-Borne Disease Prevention

In addition to monitoring and controlling annoyance mosquitoes, MMCD has insect-borne disease management responsibilities in the Twin Cities area. Since 1987, the District has monitored and controlled for the tree hole mosquito, the primary carrier of LaCrosse encephalitis. It also monitors populations of the mosquito (*Culex tarsalis*) that can carry Western Equine encephalitis, other mosquitoes that carry diseases, and the number and distribution of deer ticks in the Twin Cities area.

LaCrosse encephalitis (LAC) is a potentially serious disease affecting the brain and central nervous system. Although adults can get the illness, most cases occur in children. Of 66 cases reported in Minnesota since 1985, all but one have involved children 16 years of age or younger. Most cases of the illness occur in a relatively small area of the state. In the Twin Cities area this includes the Lake Minnetonka area and extends southeast to Dakota and Washington counties (see Figure 3.4).<sup>27</sup>

Tree hole mosquitoes, which can carry the LAC virus, breed in containers that hold water, either tree holes in hardwood forests or artificial containers such as waste tires. They rarely travel more than half a mile from their breeding site and they feed during the day. Research has found that LaCrosse encephalitis can be prevented by removing tree hole mosquito breeding sites.<sup>28</sup>

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**The District monitors and controls mosquitoes that can be carriers of disease.**

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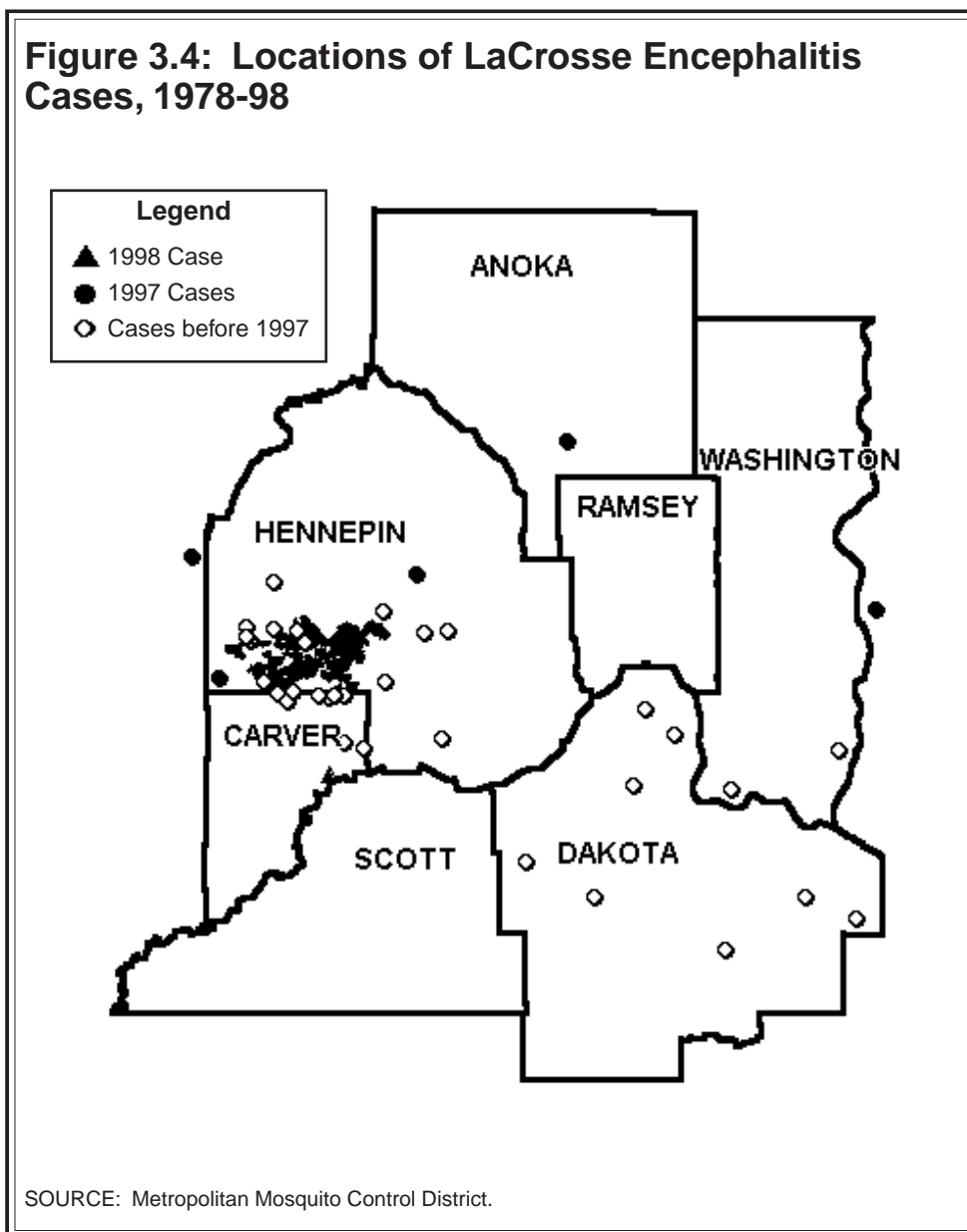
<sup>26</sup> This assumes that all sweep net and slap counts were of two-minute duration. We were unable to tell whether 6 percent of the treatments had pretreatment counts that would justify treatment because 191 records were missing a count, 17 records had a count of zero, and 32 treatment records did not indicate what type of sample collection method had been used.

<sup>27</sup> Outside of the Twin Cities area, most cases of LaCrosse encephalitis have occurred in the state southeast of the Twin Cities along the Mississippi River. Almost two-thirds of reported cases have been in Goodhue, Houston, Wabasha, and Winona counties. Winona and Houston counties contract with LaCrosse County, Wisconsin for disease prevention services, including mosquito monitoring and inspection for artificial containers. Historically, few insect-borne disease prevention services have been available in other counties.

<sup>28</sup> C. W. Hedberg, J. W. Washburn, and R. D. Sjogren, "The Association of Artificial Containers and LaCrosse Encephalitis Cases in Minnesota, 1979," *Journal of the American Mosquito Control Association* 1 (1985): 89-90.

Most cases of LaCrosse encephalitis occur around Lake Minnetonka and in the southeast portion of the Twin Cities area.

**Figure 3.4: Locations of LaCrosse Encephalitis Cases, 1978-98**



MMCD’s monitoring activities include identifying the areas that constitute the highest LAC risk, such as areas around previous cases and stands of hardwood forest near concentrations of population, especially schools or daycare centers. Each reported LAC case location is monitored approximately every two weeks. District staff visit the case site, search for containers holding water, and clean up breeding sites by moving old tires, emptying other containers, and filling tree



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**The District's response to a reported case of LaCrosse encephalitis includes public education, breeding site removal, adult mosquito spraying, and monitoring.**

holes.<sup>29</sup> They also monitor the populations of tree hole mosquitoes in high risk areas using sucomatics to collect adults and egg traps (ovitrap) to detect egg laying activity.<sup>30</sup> The District's public information efforts focus on informing the public and school children about the tree hole mosquito habitat and the need to identify and empty artificial containers.

We observed the District's response to a probable case of LaCrosse encephalitis in August 1998. Once informed of the probable case and possible exposure locations by the Minnesota Department of Health, MMCD began planning its response, assembling overview and section maps, and dividing sites into areas assigned to different teams. The District focused on the area within approximately a half a mile around the victim's home. Staff knocked on doors to hand out literature and inform neighbors about the case and its cause, searched yards for containers and possible breeding sites, collected samples of adult mosquitoes, and sprayed for adult mosquitoes. When an artificial container was found, the water was emptied from the container. If mosquito larvae were found in a container, a sample of the water and larvae was collected.<sup>31</sup>

In this case, the Department of Health identified a public horticultural area as a possible exposure location. At this location, MMCD staff looked for tree holes, focusing on stands of hardwood trees. When a wet hole was found, a sample of the water and larvae was taken. Tree holes were filled with dirt.

The results of these efforts are summarized in Table 3.5. MMCD continued to monitor the case site and the other possible exposure site every other week and used egg traps to monitor egg laying activity.

The District also monitors for *Culex tarsalis* populations, the carrier for Western Equine encephalitis, a viral disease that can affect humans but is found more often in animals. Surveillance activities consist of monitoring three sentinel chicken flocks in Anoka, Hennepin, and Scott counties. Blood samples are drawn from the chickens weekly and sent to the Department of Health for analysis to determine if the virus is present. District staff also monitor larval and adult populations of this mosquito.

The Asian Tiger mosquito (or *Aedes albopictus*), an aggressive human biter that can transmit diseases, is not established in the Twin Cities area. In 1991, this mosquito was discovered at a tire recycling facility in Scott County. An emergency response that included adult treatments and clean up of the tires, with the Pollution Control Agency's assistance, eliminated the infestation. Additional infestations of this mosquito were discovered and controlled in 1996 and 1997 in

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<sup>29</sup> In 1997, the District picked up over 36,000 waste tires either from high risk areas or because of a customer request. The District has helped to clean up tires stockpiled by commercial garages. In past years, MMCD has received some funding from the Minnesota Pollution Control Agency for its tire removal operations and some counties have reimbursed MMCD for tires removed in their jurisdictions.

<sup>30</sup> The tree hole mosquito can be found throughout the district. Not all tree hole mosquitoes are infected with the LaCrosse encephalitis virus.

<sup>31</sup> The District raises larvae samples to adults and sends them to the Department of Health, which tests to see if they were carrying the encephalitis virus.

**Table 3.5: Summary of Metropolitan Mosquito Control District Response to a Probable Case of LaCrosse Encephalitis, August 1998**

Total residences contacted	1,000
Personal contacts	400
Brochures distributed	815
Properties inspected	992
Tree holes found	127
Artificial containers found	387
Tree holes/containers breeding larvae	118
Tree holes/containers breeding tree hole mosquito larvae	91
Sucomatic adult collections	88
Adult treatments	15

NOTE: Information represents activity in the neighborhood of the child with LaCrosse encephalitis and at a public horticultural area.

SOURCE: Interview with Jeff Luedeman, Metropolitan Mosquito Control District Vector-Borne Disease Specialist, August 22, 1998.

Wright and Scott counties. MMCD continues to monitor several waste tire operations for the presence of the Asian Tiger mosquito.

**The District also monitors the distribution of deer ticks, carriers of Lyme disease, in the Twin Cities area.**

Since 1990, the District has monitored the distribution of deer ticks in the Twin Cities area. MMCD staff capture small rodents (mainly white-footed mice) from a network of 100 sites and collect any ticks attached to the rodents. In 1997, 728 animals were collected, killed, and combed for ticks. Deer ticks were found in 24 sampling locations. Most ticks were found in the northeastern part of the Twin Cities area—Anoka, northern Ramsey, and Washington counties.

The District also collaborates with a University of Minnesota researcher to monitor the presence of the ehrlichiosis agent. Ehrlichiosis is a bacterial disease that can affect humans and is carried by ticks and found in rodents. Staff draw blood from white-footed mice they collect and send it to the University for analysis. In 1997, there was one confirmed isolation of the ehrlichiosis agent in rodent blood.<sup>32</sup>

The District works closely with the Minnesota Department of Health, the state’s lead public health agency responsible for disease surveillance and prevention, in the area of insect-borne disease management. These agencies are in the process of developing a memorandum of understanding that will outline their respective responsibilities.<sup>33</sup> Generally, the District monitors and controls for mosquitoes that can transmit diseases and informs the public of these activities. The

<sup>32</sup> Metropolitan Mosquito Control District, *1997 Operational Review*: 17-18.

<sup>33</sup> We reviewed a draft of the memorandum dated July 20, 1998.

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**MMCD and the Department of Health work together to monitor and control insect-borne diseases.**

department contacts county health departments, as well as the District, and informs the public about disease cases. MMCD reviews results of surveillance activities. If MMCD sees any unusually high populations of tree hole mosquitoes during its surveillance activities it notifies MDH which issues a warning.

The preliminary agreement also states that upon a request from the Department of Health, the District may provide mosquito-borne disease surveillance and control outside the District. In 1997, the District provided these services at a LaCrosse encephalitis case site in Delano, just outside of the District boundary. Representatives of the District have also participated in Department of Health meetings held in southeastern Minnesota and have served as a resource for counties outside the Twin Cities area.

- **Epidemiology staff at the Minnesota Department of Health told us that the District has played a valuable role in preventing the transmission of mosquito-borne diseases, such as LaCrosse encephalitis, and monitoring deer ticks.**

Department of Health staff said they do not doubt that MMCD efforts to remove artificial containers, monitor past LAC case sites, and educate the public have reduced the risk for LaCrosse encephalitis transmission. For disease prevention, the Health Department considers spraying for adult mosquitoes to be secondary to eliminating breeding sites.

MMCD has one full-time staff member designated as the insect-borne disease specialist. Since 1998 the person in this position has also served as a region group leader and has estimated that he spends about 40-50 percent of his time on insect-borne disease activities. Among other responsibilities, the insect-borne disease specialist is supposed to ensure that staff in other regional offices are properly trained in monitoring procedures. Given the prominence and priority of public health issues, we suggest that the District should consider increasing the insect-borne specialist position to a full-time position.

## Refused Treatment Requests

MMCD statutory language states that District employees may “enter upon any property” for mosquito control purposes, “subject to the paramount control of the county and state authorities.”<sup>34</sup> In 1982, the Legislature amended language related to the District’s access to private and public property. One amendment gives private landowners the right to refuse the District access to their property “except for control of disease bearing mosquito encephalitis outbreaks.”<sup>35</sup> A second amendment requires the Commissioner of Natural Resources to allow the District to enter Department of Natural Resources property for mosquito control purposes.<sup>36</sup> Although state law restricting the District’s access to property does not specifically apply to public lands managed by DNR, cities, and townships, the

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<sup>34</sup> *Minn. Stat.* §§473.704, subd. 17.

<sup>35</sup> *Minn. Laws* (1982), ch. 579, subd. 6.

<sup>36</sup> *Ibid.*

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**Since 1982,  
private land  
owners have  
had the right to  
refuse the  
District access  
to their  
property.**

District's current procedures allow both private property owners and public property managers to refuse access for larval and/or adult mosquito control activities. This section discusses MMCD's policy and procedures for refused treatment properties and presents information on refused treatment properties.

The District's adult mosquito treatment policy, revised June 1, 1998, contains a section titled "requests of no treatment." The policy recognizes that private citizens may request that the District not perform adult mosquito control on their property and states that the District will honor these requests. The policy states that "the District will maintain a buffer around citizens who request that [the District] stay a distance away from their property for cold fogging operation."<sup>37</sup> The policy also states that if a community requests that the District not treat its property, "the District will attempt to honor the request but retains the right to make the decision based on health or severe annoyance. If infestations reach levels which affect health or cause severe public annoyance, the District retains the ability to do adult mosquito control."<sup>38</sup>

The District's *Field Operations Manual* contains procedures for refused treatment requests taken by staff at the headquarters office or staff at the regional offices. The District revised its refused treatment procedures in April 1998. The procedures were similar in prior years with the exception that in 1998 requests were required to be in writing. According to MMCD staff, this change was made to address concerns about being able to accurately locate a property and to minimize possible misrepresentations made on the telephone.

For all requests received, staff at the regional office fill out a "Refused Entry/No Control Field Form," update the section maps and cards identifying the property in question as a refused entry or treatment area, attach a copy of the map to the field form, and file the request.<sup>39</sup> Staff mark the refused treatment status of the request using the options listed in Figure 3.5. Then staff send a copy of the field form with the updated map to the headquarters office. The procedures indicate that staff at headquarters will enter the information into a computerized database maintained at the headquarters office.

The adult mosquito control procedures also contain instructions on treatment restrictions for refused treatment property. Specifically,

- **MMCD has provided a 100- to 600-foot buffer zone in all directions around each refused treatment property depending on the type of insecticide being used and the method of application.**

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<sup>37</sup> Metropolitan Mosquito Control District Adult Mosquito Treatment Policy, *Administrative Manual*, June 1, 1998: 2. The June 1998 revision of the adult mosquito treatment policy did not change the refused treatment language.

<sup>38</sup> *Ibid.*

<sup>39</sup> The Refused Entry/No Control Field Form collects information on the date of the request, name, address, type of property (public or private property or other), location of property (county, township, section), legal description, acres, wetland type, and status of and reason for the request.

**Figure 3.5: Options on Refused Treatment Form**

Mosquito Larval Control	Adult Mosquito Control
1. Refused entry/Keep out	1. Keep away
2. Monitor only/No control	2. Keep away and notify before backpacking
3. Notify/Get permission to monitor	3. Keep away and notify before cold fogging
4. Change from refused entry to monitor only or special response	4. Keep away and notify before any adult control
5. Remove from refused entry	5. Remove from keep away list

SOURCE: Metropolitan Mosquito Control District, Refused Entry/No Control Field Form.

**MMCD policies and procedures provide for a buffer zone for property owners who refuse mosquito control treatments.**

The District's no treatment buffer zones for refused treatment properties are:

- a 100-foot radius for treatments of harborage areas with permethrin applied with a backpack carried by an applicator or mounted on an all-terrain vehicle (ATV);
- a 600-foot radius for evening applications of resmethrin applied with a truck- or ATV-mounted cold fogger; and
- a 200-foot radius for resmethrin applied with a hand-held cold fogger.<sup>40</sup>

The District established these buffer zones by doubling the swath width of the application device to provide a wide margin around a refused treatment property. For example, a truck- or ATV-mounted cold fogger has a swath width of 300 feet in each direction; the District doubled this distance to establish its buffer zone of 600 feet.<sup>41</sup> Some other states address the refused treatment issue by turning off the applicator in front of a refused treatment property or by notifying people prior to treatment and asking them to close their house windows or leave their property.<sup>42</sup>

Prior to adult control applications, procedures direct MMCD staff to examine the map of the area to be treated to become familiar with the area, identify bodies of water, refused treatment property, and other features with treatment restrictions, and plan the treatment routes based on weather conditions.<sup>43</sup> Staff also call people

<sup>40</sup> Metropolitan Mosquito Control District, Adult Mosquito Control Procedures, *Field Operations Manual*, May 1998: 7, 10.

<sup>41</sup> The product labels for Scourge (resmethrin) and Permethrin 57% OS do not contain recommended buffers for refused treatment properties.

<sup>42</sup> Florida, Michigan, New York, Virginia, Washington, and South Cook County, Illinois.

<sup>43</sup> This is not a comprehensive list of tasks conducted prior to an adult control treatment, but represents those tasks related to refused treatment properties.

who have requested notification of treatment in their area. If there is any question about an area to be treated (such as too close to fish, refused entry, or a sensitive person) staff are directed to discuss the situation with their team leader or group leader before treating the area.<sup>44</sup>

- **Our analysis of refused treatment properties was limited because, contrary to its internal procedures, the District has not maintained a computerized database of refused treatment properties since 1995.**

In 1995, property owners or managers of approximately 57,000 acres of land had restricted access to MMCD. Comparing these data with the District's master breeding site file showed that approximately 26,100 acres (or 45 percent) of the refused treatment acres in 1995 were located in wetland mosquito breeding sites, representing about 14 percent of all breeding acres. Most refused treatment acres were located in Anoka and Scott counties, with over 7,000 and 6,000 acres each, respectively. Approximately 28 percent of these acres were located in Priority Area 1, with 34 percent in Priority Area 2, and 38 percent in Priority Area 3.

About 42 percent of the refused treatment acres in 1995 were requests from public agencies. To gather current information, we interviewed representatives of public agencies we could identify who have refused access to MMCD (see Table 3.6). The acres represent a combination of breeding sites producing mosquito larvae and property that could be treated to kill adult mosquitoes. Some public refused-access property contains large mosquito breeding sites, such as the U.S. Fish and Wildlife and Department of Natural Resources (DNR) land located in the Minnesota River valley. Most public agencies we contacted have refused both larval and adult control treatments.

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**Public land managers who refused treatment did so for conservation and ecological reasons or because of concern about insecticides.**

The District has entered into memoranda of agreement with DNR, the Suburban Hennepin Park District, and Minneapolis Parks to clearly articulate specific details of their refused treatment requests. The specifics of each memorandum of agreement vary among these entities, making generalization difficult. For example, the 1995 agreement with Hennepin Parks specifies treatment conditions based on the nature of specific parks or recreation areas. No treatment of any kind is allowed in some nature centers, while some wetlands in other parks may be treated with larval insecticides.<sup>45</sup>

We asked agency representatives why they refused treatment and their responses fell into several categories. The U.S. Fish and Wildlife Service, DNR, nature centers, and some others cited issues related to compatibility with conservation and ecological concerns related to killing both mosquito larvae and adults. According to these representatives, mosquitoes are an integral part of a balanced food web or chain. Chemical treatments that could create an imbalance in the food web would be incompatible with the purposes of these agencies and

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<sup>44</sup> Metropolitan Mosquito Control District, Adult Mosquito Control Procedures: 6-7, 9, 10-11.

<sup>45</sup> Memorandum of Agreement Between Hennepin Parks and the Metropolitan Mosquito Control District Regarding Control of Mosquitoes and Black Flies on Property Owned and/or Managed by Hennepin Parks, effective date Feb. 1995.



**Table 3.6: Selected Public Agencies Refusing Access to Metropolitan Mosquito Control District**

Public Agency	Estimated Acres	Year Initiated	Refused Treatment for Larval, Adult, Both
U.S. Fish & Wildlife Service:			
Minnesota Valley Wildlife Refuge	10,000	1985	Both
Department of Natural Resources	42,497 <sup>a</sup>	1989	Both
Chanhassen	500	1992	Adult control on city property
Maplewood	500	1993	Adult control on city property
St. Paul Parks:			
Hidden Falls Park	800	1992	Adult control
Crosby Nature Park			Both
Lilydale Park			Both
Minneapolis Parks <sup>b</sup>	5,200	1996	Adult control
Hennepin Parks	larval - 3,800 adult - 25,000	1970s	Varies depending on the park
Town of Grant	14	1993	Both
Columbus Township <sup>c</sup>	30	1993 to 1998	Was both
Nature Centers/Areas:			
Spring Brook, Fridley	127	1978	Both
Innsbrook, Fridley	25	1978	Both
Westwood Hills, St. Louis Park	150	Late 1980s	Both
Woodlake, Richfield	150	1988	Both

NOTE: In addition, the North Oaks Company and North Oaks Homeowners Association requested in 1997 that about 4,000 acres of property not be treated for larval or adult mosquito control.

<sup>a</sup>Represents all Department of Natural Resources-administered land in the Twin Cities metropolitan area.

<sup>b</sup>Minneapolis Parks refused treatment policy changed from no larval or adult treatment since 1992 to no adult treatment in 1996.

<sup>c</sup>At a meeting on August 26, 1998 the Columbus Township Board reversed its refused treatment policy effective immediately.

SOURCES: Office of the Legislative Auditor telephone interviews, Summer 1998; memoranda of agreement between Metropolitan Mosquito Control District and Department of Natural Resources, Hennepin Parks, Minneapolis Parks, various dates, on file at the Office of the Legislative Auditor.

organizations. Concern was also expressed about the impact on nontarget species. Community representatives, whose properties would be most affected by treatments for adult mosquitoes, cited public health concerns about insecticides.

We also asked agency representatives to rank their satisfaction with MMCD honoring their request. Most people responded that they were “satisfied” or “very satisfied.” Some people who were dissatisfied told us about situations from the late 1980s and early 1990s when the District publicly blamed agencies refusing treatment for the District’s inability to control mosquitoes. Agency representatives described the relationship with the District as tense and competitive during these years. Some people acknowledged that with the change in director at MMCD in 1994 working relationships had improved and were not so antagonistic, and the District staff had stopped directing citizen complaints to

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**The District received 600 additional refused treatment requests in 1998.**

agencies refusing treatment. According to a DNR representative, agency staff were “very dissatisfied” with MMCD because the District treated refused treatment land in a scientific and natural area in 1997 and again in 1998. In both years, DNR staff contacted MMCD to complain about the treatments. MMCD staff told us that because the boundaries of the area had expanded there was confusion about what land was owned by DNR.

During the spring and summer of 1998, an environmental group encouraged people to contact the District and request refused treatment status for their property. Based on information from MMCD and our analysis of MMCD telephone customer requests, the District received about 600 additional refused treatment requests in 1998.<sup>46</sup> This compares with about 100 requests received in 1997.<sup>47</sup> Nearly one-half of the 1998 requests were from Hennepin County, followed by Ramsey County with 17 percent, and Dakota and Washington counties with about 13 percent each. MMCD has not compiled the 1998 requests in a computerized database, which limited our ability to draw conclusions about the nature of or the number of acres involved with these requests.

MMCD has conducted a telephone survey of residents in the Twin Cities area every two years since 1994. The 1998 survey was the first to ask about the general public’s awareness of their right to refuse entry. Of the 422 people surveyed, about one-third (34 percent) responded that they were aware that “citizens have the right to request that their property not be treated by MMCD.”

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**About 34 percent of citizens surveyed by MMCD were aware that they have a right to refuse mosquito control treatments.**

In August 1998, we surveyed a random sample of people who had called MMCD to request service, refuse service, or ask for information in 1997.<sup>48</sup> Nine percent (or 23) of the respondents to our survey, said they called to request that their property not be treated with mosquito control insecticides. These respondents said they refused mosquito control treatment for a variety of reasons.<sup>49</sup> When asked to rank their satisfaction with MMCD’s response to their request, 14 respondents indicated that they were “satisfied” or “very satisfied,” while 5 people responded that they were “dissatisfied” for different reasons.

As discussed above, the District’s current procedures allow both private property owners and public property managers, including the Commissioner of Natural Resources, to refuse treatment for larval and/or adult mosquito control activities, even though state law specifically allows the District to enter DNR property for mosquito control purposes. Based on our review of state law, we concluded that:

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<sup>46</sup> During Summer 1998, MMCD staff responded to new refused treatment requests in writing. The content of those letters and the District’s relationship with the public is discussed further in Chapter 5.

<sup>47</sup> Telephone conversation with Jim Stark, Public Affairs Representative, October 27, 1998.

<sup>48</sup> Approximately 2,600 people called the District in 1997 for various reasons. In August 1998, we mailed a questionnaire to a random sample of 368 citizens who had called the District in 1997. Of these, 248 responded for a response rate of 67 percent.

<sup>49</sup> The survey instrument asked people to indicate the reason they refused treatment and included: concern about effects of insecticides on people, frogs, birds, bees and other insects, wildlife, cattle, horses, or other animals; support a natural approach; do not want chemicals in their property; a chemically sensitive person lives on the property; or the property contained gardens or orchards.

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**Property access language in state law treats the Department of Natural Resources differently than other state agencies.**

- **Language contained in state law related to the Metropolitan Mosquito Control District’s access to public property is unclear and contradictory.**

*Minn. Stat.* §473.704, subd. 17 says the District may “enter upon any property” to clean up stagnant pools of water and other mosquito breeding sites, “subject to the paramount control of the county and state authorities.”<sup>50</sup> It is not clear whether this limitation also applies to the application of insecticides used to kill mosquito larvae and adults or other activities of the District. A 1982 amendment to this subdivision requires the Commissioner of Natural Resources to allow the District to enter DNR property for mosquito control purposes, but the original “paramount control” language remains.<sup>51</sup> In other words, state law allows counties and state authorities the right to determine what mosquito control activities occur on their land, but then goes on to remove that right from the Department of Natural Resources. Based on the current language in state law, most of the public agencies (cities and towns) currently refusing access to MMCD do not legally have the right to do so (see Table 3.6). We suggest that:

- **The Legislature should consider whether state law should allow the Department of Natural Resources and local units of government, including cities and townships, the right to refuse access to MMCD, except for monitoring and treatment of mosquitoes that carry disease.**

Over 40 percent of the refused access or “no treatment” acres in 1995 were requests from federal or state agencies, or local governments, including the Minnesota Department of Natural Resources, the cities of Maplewood and Chanhassen, and Minneapolis and Hennepin parks. Staff from these entities cited issues related to compatibility with conservation and ecological goals and concerns about insecticides as reasons for refusing treatment. We think that there are some situations when the Department of Natural Resources and local units of government should be allowed to determine whether mosquito control activities are conducted on public property. In some situations, the goals of public agencies and MMCD may be in conflict. Specifically, we believe that entities managing public land for ecological and natural resource reasons should have the right to refuse mosquito control treatments. This argument would apply to federal, state,

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<sup>50</sup> *Minn. Stat.* §473.704, subd. 17 reads: “Entry to property. Members of the commission, its officers, and employees while on the business of the commission, may enter upon any property within or outside the district at reasonable times to determine the need for control programs. They may take all necessary and proper steps for the control programs on property within the district as the director of the commission may designate. Subject to the paramount control of the county and state authorities, commission members, officers and employees of the commission may enter upon any property and clean up any stagnant pool of water, the shores of lakes and streams, and other breeding places for mosquitoes within the district. The commissioner of natural resources shall allow the commission to enter upon state property for the purposes described in this subdivision. The commission may apply insecticides approved by the director to any area within or outside the district that is found to be a breeding place for mosquitoes. The commission shall give reasonable notification to the governing body of the local unit of government prior to applying insecticides outside the district on land located within the jurisdiction of the local unit of government. The commission shall not enter upon private property if the owner objects except for control of disease bearing mosquito encephalitis outbreaks.”

<sup>51</sup> In contrast, state laws relating to local mosquito abatement boards (*Minn. Stat.* §§18.041-18.161) provide that local mosquito abatement plans are subject to DNR approval, modification, and revocation. (*Minn. Stat.* §18.121, subd. 2.)

or local entities with a mission to manage land to protect and preserve natural areas and to provide recreation and educational opportunities in natural settings consistent with conservation and ecological concerns. Agencies, such as MMCD, that want an exception from the paramount control of these public land managers should have to prove to the Legislature why such an exception is warranted.

The Legislature may also want to consider formally extending the ability to refuse access to MMCD to cities and townships, whose officials are concerned about the use of insecticides on public property. In this manner, cities and townships would have the same right to refuse access to MMCD that is currently available to county and state authorities and to private property owners.

We also recommend that:

- **The Metropolitan Mosquito Control Commission should develop a refused treatment policy that addresses both larval and adult mosquito control activities.**

Currently, the only policy statement related to refused treatment is included in the District's adult mosquito treatment policy. The District does not have a written policy for refusing larval control treatments, although the right to refuse treatment applies to larval insecticides. We believe a well articulated, comprehensive refused entry policy would be beneficial for the District, private landowners, public agencies, and units of government in the Twin Cities area.

In the past the District has maintained a refused treatment request indefinitely. According to MMCD staff, the District may require an annual renewal of refused treatment requests in 1999. Given the sensitive nature of this issue, we believe that an annual renewal requirement belongs in a refused treatment policy that has been reviewed and approved by the Commission.

Finally, as noted above, contrary to what is stated in its refused entry procedures, MMCD has not maintained computerized refused entry data files since 1995. We recommend that:

- **The Metropolitan Mosquito Control District should maintain a separate computerized database for refused entry requests involving private and public land.**

The District should develop a comprehensive, up-to-date refused entry database, containing names, addresses, property locations, and status. This will allow MMCD to more effectively monitor the status of these properties and contact property owners or managers if needed to verify changes in ownership or the refused treatment status of a property.

State law and MMCD's current refused treatment procedures with generous buffer zones create the potential for conflict between a person who does not want treatment and neighbors who do. To balance the interests of people who want treatment with those who do not, MMCD could reduce the size of its buffer zone

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**The District  
may require an  
annual renewal  
of refused  
treatment  
requests  
beginning in  
1999.**

or adopt other methods of addressing refused treatment situations. Aside from that approach, balancing these interests becomes a policy issue that the Legislature may want to address.

## BLACK FLY CONTROL ACTIVITIES

The Minnesota Department of Natural Resources regulates activities on the state's public waters. Because MMCD controls the black fly population by pouring liquid *Bti* into rivers and small streams, it must obtain a DNR permit annually. MMCD's permit application reviews the activity and efficacy of the black fly program for the previous year. The permit issued by DNR specifies the insecticides that can be used for black fly treatments, treatment thresholds, and possible treatment sites. For river treatments, the permit also requires efficacy sampling and specifies the maximum dose of *Bti* allowed.

The black fly program began in 1983, when MMCD started testing for black fly larvae (*Simulium venustum*) on small streams. MMCD established over 500 test sites on streams throughout the Twin Cities area and began treatments in 1984. Since then, a number of sites have been dropped from MMCD's list of possible treatment sites. As Table 3.7 shows, MMCD treated 65 small stream sites in 1997.

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**The District's  
black fly  
control  
program began  
in 1983 on small  
streams.**

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**Table 3.7: Metropolitan Mosquito Control District  
Black Fly Program Activity, 1995-97**

Year	River	River Treatments ( <i>S. luggeri</i> , <i>S. johansenni</i> , <i>S. meridionale</i> )		Stream Treatments ( <i>S. venustum</i> )	
		Treatments	Sites Treated	Treatments	Sites Treated
1997	Crow	3	2		
	Minnesota	30	7		
	Mississippi	13	2		
	Rum	<u>19</u>	<u>2</u>		
	Total	65	13	65	65
1996	Crow	5	2		
	Minnesota	21	7		
	Mississippi	9	2		
	Rum	<u>32</u>	<u>4</u>		
	Total	67	15	74	74
1995	Crow	7	2		
	Minnesota	22	6		
	Mississippi	15	2		
	Rum	<u>14</u>	<u>2</u>		
	Total	58	12	47	47

SOURCE: Metropolitan Mosquito Control District.

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**Currently, the District treats four large rivers, as well as small streams, to kill black fly larvae.**

In the mid-1980s, MMCD realized that a large black fly population was emerging from Minnesota rivers as well as small streams. In 1987, MMCD began experimental treatments for three species of black flies on rivers—*Simulium* (*S.*) *luggeri*, *S. johansenni*, and *S. meridionale*. After a series of studies assured DNR that black fly treatments would not have long-term significant impacts on other species, black fly operational treatments began in 1992. Currently, the MMCD is permitted to treat 21 sites: 3 on the Mississippi, 5 on the Rum, 6 on the Crow, and 7 on the Minnesota River. The DNR requires MMCD to continue monitoring nontarget species on the Mississippi River as a permit condition.

There are two criteria that larval samples must meet before MMCD will treat: (1) the number of larvae must meet or exceed the threshold established by MMCD and DNR and (2) the majority of the larvae must be near the pupal stage. MMCD testing stations on the Minnesota, Crow, Rum, and Mississippi rivers consist of three buoys, each with two mylar strips attached. When checking for threshold, MMCD collects five of the six strips at a site. The average per strip must reach 100 *S. luggeri*, or 40 *S. johansenni* or *S. meridionale* (or a combination of the two) before MMCD will treat. In small streams, sites are tested by a field worker grabbing a handful of submerged vegetation. The threshold for *S. venustum* is 90 larvae per “grab.”<sup>52</sup> MMCD tries to target its treatments when the majority of the black fly larvae are near pupation, but before they stop feeding. MMCD does this to leave live black fly larvae in the streams and rivers as long as possible. According to MMCD, if a site meets threshold but the larvae are not far enough along in development, MMCD will not treat.

Table 3.7 shows black fly treatment activity for 1995 through 1997. MMCD treats for *S. venustum* in small streams once each year. The number of treatments have ranged from 47 in 1995 to 74 in 1996. MMCD may treat sites on large rivers for the other three species of black flies more than one time per year when larval samples meet threshold. For example, the District made 19 treatments at 2 sites on the Rum River in 1997.

## DATA MANAGEMENT ISSUES

The District uses treatment records to compile year-end summaries and to inform its board, county commissioners, legislators, and the public about its activities. Until 1997 the District contracted with an outside firm for data entry services. To save costs, this function was brought in house starting in 1997. While the 1995 and 1996 computer records appear to be in reasonably good condition, we found that:

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<sup>52</sup> In 1990, the treatment threshold for *Simulium* (*S.*) *venustum* was set at 10 larvae per “grab,” but *S. venustum* was not very prevalent in adult counts conducted by MMCD. Both DNR and MMCD began to question whether *S. venustum* was a problem. The two organizations agreed to increase the threshold for *S. venustum* by 10 each year. If the number of adult *S. venustum* increased or complaints from the public increased, then the threshold could be revisited.



- **There were too many errors in the District's computerized treatment records for 1997 to be used to reliably describe mosquito control activities.**

When we compared the 1997 treatment records to MMCD's 1997 audited inventory records, we found differences greater than 5 percent for some insecticides. We also found that some inaccuracies were concentrated in individual regional offices. Therefore, we could not use the data to analyze where the District applied larval and adult insecticides in 1997. We recommend that:

- **The District should establish rigorous quality control standards for its treatment data if it intends to use these data to accurately assess its activities, conduct future planning, and inform the public about its activities.**

We have discussed this issue with MMCD staff who had already established procedures during the summer of 1998 to compare internal inventory records with treatment data. The comparison aided in the identification and correction of some problems with the 1998 treatment data. We urge the District to continue these efforts and to refine them as necessary. As a result of the quality control checks that the District instituted for 1998, we were more comfortable using its 1998 treatment data. MMCD's 1998 treatment data reported district-wide material use very close to that recorded in its inventory records. However, we identified some problems with the quality of the District's 1998 data. For example, the amount of resmethrin used by one facility according to its treatment records was over 15 percent higher than the use indicated by the inventory.

Given the time devoted to collecting and recording the information, we recommend that:

- **The District should identify and focus its data collection efforts on items that are necessary to meet regulatory requirements, document effectiveness, and inform policy makers and the public about its activities.**

Only data which are needed and are most likely to be used to meet some purpose should be collected. MMCD might also consider whether all of the data that are collected need to be recorded in the computer records.

## COMPLIANCE WITH PESTICIDE REGULATIONS

The primary regulators of MMCD activities are the Minnesota Department of Agriculture and the Minnesota Occupational Safety and Health Administration (OSHA), a division of the Department of Labor and Industry. The Department of Agriculture regulates the registration, labeling, storage, application, and use of

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**The District initiated measures to improve its treatment data in 1998.**

insecticides and the licensing of applicators pursuant to federal and state laws and rules. It also investigates citizen complaints and incidents involving MMCD's use of insecticides. We talked with Department of Agriculture staff and reviewed their enforcement files and found that:

- **To the best of our knowledge, MMCD usually has applied insecticides according to label directions and in compliance with state regulations.**

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**The District reported 15 incidents of pesticide spills between 1979 and 1997.**

According to the Department of Agriculture staff, MMCD has a good record of complying with pesticide rules and regulations. Department of Agriculture pesticide enforcement records show that between 1979 and 1997 MMCD reported 15 incidents or spills of control materials. The most recent incident occurred in 1996. About one-half of the spills involved *Bti* granules, a dry larval insecticide, and about one-third involved liquid adult insecticides.

The Department of Agriculture conducted three routine inspections of MMCD regional offices in recent years—two in 1994, and one in 1995. The inspection at one facility resulted in several noncompliance notations, including: a release response plan was not on file at the facility, an incident notification sign was not posted, incident training was not provided, and insecticides were stored with an incomplete label.

Between 1986 and 1997, the Department of Agriculture investigated seven complaints filed by citizens against MMCD. Most of the complaints were not substantiated. Two complaints resulted in enforcement actions. A 1991 complaint involving an exposure violation resulted in a civil enforcement action (Notice of Intent) and MMCD paid a settlement penalty of \$1,000. A 1997 complaint involving the use of an insecticide (resmethrin) inconsistent with label instructions resulted in a Notice of Violation because the applicator was not properly licensed. According to Department of Agriculture records, the employee had completed the required training, but the District had not submitted the application and licensing fee to the department in a timely manner. It is possible that other employees who were not properly licensed had applied resmethrin during the summer of 1997 before being licensed in August. A review of the Department of Agriculture applicator records revealed that over 30 other MMCD employees were licensed in August 1997, at the same time as the employee cited in the above violation.

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**Between 1986 and 1997, the Department of Agriculture investigated seven complaints against MMCD.**

The dose of insecticide used affects its toxicity. Therefore, calibration of the equipment used to apply insecticides is of critical importance. MMCD has documented procedures and maintained calibration records for the backpacks, sprayers, and foggers used to apply resmethrin and permethrin in 1998. Generally, backpacks have been calibrated after 30 minutes of use or about two times a summer. Since dosage regulators for the backpacks and sprayers are internal to the unit, staff applying the insecticides can not adjust the application rate in the field. The hoppers used to dispense *Bti* granules and methoprene pellets from helicopters have been calibrated using field tests every spring.

Insecticide regulations require that people applying restricted use pesticides be licensed applicators. MMCD applies resmethrin, a restricted use pesticide, most often in the evening using a cold fogger. MMCD licenses more employees than

are required for its operations. In 1997, about 60 percent of control operations staff were licensed as noncommercial insecticide applicators. MMCD also provides insecticide applicator training for its own employees and for employees of other jurisdictions.

The Department of Labor and Industry is responsible for ensuring safe and healthy working conditions for Minnesota workers. OSHA does not have any record of complaints, inquiries into complaints, inspections, or investigations at any MMCD facility in the past 10 years.

## CONCLUSIONS

The Metropolitan Mosquito Control District reduced the number of acres treated with insecticides by 15 percent in 1998—from 231,200 acres in 1997 to 197,500 acres in 1998. Our review of the District's treatment and inventory data reveals that mosquito breeding sites represented nearly two-thirds of the acres treated in 1998. The insecticides used to kill mosquito larvae accounted for over 91 percent of insecticide costs in 1997.

We also examined the District's use of pretreatment thresholds to justify applying insecticides and found that in nearly all cases the sites treated for both larval and adult mosquito control met the thresholds. Epidemiology staff at the Department of Health think that the District plays a valuable role in the prevention of mosquito-borne diseases, but think that spraying for adult mosquitoes should be secondary to eliminating mosquito breeding sites. Based on conversations with staff at the Department of Agriculture and a review of enforcement files, it appears that the District usually has applied insecticides according to label directions and has complied with state regulations for the application of insecticides.

The District's current adult mosquito treatment policy gives more emphasis to responding to citizen requests than did earlier policies. It appears that MMCD does not follow its 1998 adult mosquito treatment policy. Contrary to its policy, the District provided adult mosquito treatments to some for-profit enterprises and private functions in 1998. We recommend that the Commission review the District's existing policies and procedures and adopt a comprehensive adult mosquito treatment policy. We also recommend that the District reexamine its adult mosquito treatment practices to ensure that they conform with its adult treatment policy.

After reviewing state law related to District access to public property, we concluded that the language contained in state law is unclear and contradictory. We suggest that the Legislature consider clarifying language in statute and decide whether state law should allow the Department of Natural Resources and local units of government the right to refuse the District access to public property, except for monitoring and treatment of mosquitoes that can carry diseases. We also recommend that the Commission develop a comprehensive refused treatment policy for both larval and adult mosquito control.

Our analysis of adult mosquito treatments and refused treatment requests was limited because of problems with MMCD's data. We recommend that the District focus its data collection efforts, develop rigorous quality control standards for its treatment data, develop clear criteria and instructions for collecting data, and maintain a separate database for refused entry requests.

In addition to problems with data management, we found a number of seemingly isolated problems with MMCD's operations. Examples include the untimely filing of pesticide applications and licensing fees with the Department of Agriculture in 1997, mistaken application of insecticides in both 1997 and 1998 at a scientific and natural area that the Department of Natural Resources had asked not to be treated, and failure to maintain computerized data files for refused treatment properties. Taken together, these problems suggest a lack of attention to detail and vigilance on the part of District staff. It is the responsibility of District management to place greater emphasis on quality controls necessary to identify, correct, and avoid these problems in the future.

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# Effectiveness of Mosquito Control

## CHAPTER 4

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The Metropolitan Mosquito Control District's (MMCD) mission is to “promote health and well being by protecting the public from disease and annoyance caused by mosquitoes, black flies and ticks, in an environmentally sensitive manner.” The goals of the District’s mosquito control efforts are to reduce regional populations of human-biting mosquitoes and black flies.<sup>1</sup> We asked:

- **Is the Metropolitan Mosquito Control District effective at reducing larval and adult mosquito and black fly populations?**
- **How does the District measure its effectiveness?**

To answer these questions we reviewed annual operational reviews and other reports on the District’s activities, interviewed District staff, analyzed treatment databases, and talked with entomologists in state agencies and at the University of Minnesota.

Measuring the effectiveness of mosquito control programs is difficult because it is hard to predict what “would have been” without intervention. Results of District-sponsored studies on the overall effectiveness of mosquito control efforts have been inconclusive. Instead, the District has tested the effectiveness of insecticides and used results of those material efficacy tests to document the effectiveness of mosquito control.

Overall we found that most of the insecticides used by MMCD to kill larvae do not meet the District’s goal of killing 95 percent of larvae. Methoprene products used to kill cattail mosquito larvae have performed the best (92 to 99 percent control), while the average control achieved with *Bti* granules ranged from 78 to 89 percent control in 1995-97. We have some concerns about the methods MMCD used to calculate the efficacy of methoprene products used to kill floodwater mosquito larvae. In 1996, the District conducted efficacy tests on the insecticides used to kill adult mosquitoes and estimated that the average adult mosquito reduction in treated sites was about 57 percent. In 1998, the District collected pre- and post-treatment adult mosquito counts from over 500 sites, which showed a 90 percent reduction in the number of adult mosquitoes after

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<sup>1</sup> Metropolitan Mosquito Control District, *1998 Budget*, 4; Metropolitan Mosquito Control District, *Self-Assessment of Performance*, 1994: 9, 13, 24.

treatment. However, we have some concerns about using these data to evaluate the effectiveness of adult insecticides.

## HISTORY

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### The District has attempted to address questions of effectiveness since the 1970s.

The Metropolitan Mosquito Control District has a long history of attempting to address questions of effectiveness. In a 1977 Environmental Impact Statement (EIS), the District used adult mosquito population data collected using light traps to estimate that the District's larval control program reduced mosquito annoyance by 87 percent at the center of the District.<sup>2</sup> A Supplemental EIS estimated that people can tolerate slightly over two mosquito bites in a five minute period and used field trials to document the effectiveness of individual insecticides used by MMCD.<sup>3</sup> The District also sponsored studies on the public perception of mosquito annoyance in 1990 and on the prevalence of adult mosquitoes in the District in 1993, conducted biennial public opinion surveys since 1994, and sponsored internal studies on the effectiveness of insecticides used.

A 1994 report by an Environmental Quality Board Mosquito Control Technical Work Group recommended, among other things, that MMCD should clearly define its mission, goals, and objectives.<sup>4</sup> Later that same year, the District completed a self-assessment of performance in which it identified goals, performance objectives and measures, and plans for improving these measures in future years.<sup>5</sup> The District has not revised its 1994 self-assessment, although its annual operational reviews provided updated information on some of the performance measures contained in the self-assessment. The District should reexamine the performance measures in its 1994 self-assessment to see if any performance measures could be added in its annual operational review.

The Environmental Quality Board Work Group also recommended that MMCD initiate a process to study efficacy issues and establish an interagency panel to oversee these studies.<sup>6</sup> MMCD created the Interagency Panel on Metropolitan Mosquito Control District Effectiveness, composed of representatives from state agencies, with participation by representatives from local governments and environmental groups.<sup>7</sup> The panel met eight times between 1994 and 1996 to help MMCD develop methods to measure its effectiveness. The panel considered both objective, physical measures (such as insect counts) and people's perceptions as it

<sup>2</sup> Metropolitan Mosquito Control District, *Final Environmental Impact Statement: Options for Control to the Year 2000*, 1977: 3, 199, ei-28 - ei-34.

<sup>3</sup> Metropolitan Mosquito Control District, *Supplemental Environmental Impact Statement [Draft]*, November 1986: II-6.

<sup>4</sup> Environmental Quality Board, Mosquito Control Technical Work Group, *Final Report*, April 1994: 3.

<sup>5</sup> Metropolitan Mosquito Control District, *Self-Assessment of Performance, 1994*, October 1994.

<sup>6</sup> Environmental Quality Board, Mosquito Control Technical Work Group, *Final Report*, April 1994: 3.

<sup>7</sup> The state agencies represented on the interagency panel included the departments of Agriculture, Natural Resources, and Transportation, the Pollution Control Agency, and the Office of Environmental Assistance.



attempted to determine if MMCD's mosquito control efforts actually reduced the numbers of biting insects and improved the quality of life in the Twin Cities.<sup>8</sup>

The Interagency Panel identified many measures such as weather, mosquito breeding habitat, people's behavior and perceptions, and costs that would be helpful in analyzing effectiveness. It also concluded that predicting what "would have been" without intervention would be difficult. The panel sponsored a focus group to gather information on people's perceptions of the mosquito problem and a project using geographic information system (GIS) technology to analyze and predict mosquito production from treated and untreated breeding sites for a particular rainfall event. In early 1996, following the District's budget reduction, the panel concluded that it had completed its charge to assist MMCD with developing methodologies and identifying resources and tools needed to measure its effectiveness and it turned over implementation to the District.

## MOSQUITO CONTROL

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**The District's goal is to kill 95 percent of mosquito larvae or adults when it uses insecticides.**

To achieve its goal of reducing regional populations of human-biting mosquitoes, the District treats breeding sites to kill mosquito larvae. It also sprays insecticides to kill adult mosquitoes as needed and requested.<sup>9</sup> To measure effectiveness the District evaluates the efficacy of the insecticides it uses to kill mosquito larvae and adults and analyzes citizen tolerance and expectations. The District's goal is to kill 95 percent of mosquito larvae or adults when it uses insecticides. This goal is based on guidelines established by the Environmental Protection Agency for all insecticides and principles of integrated pest management, which emphasize using just enough insecticide to kill the targeted insect without overusing the product. However, achieving 95 percent control using *Bti* and methoprene, which are more specific to mosquitoes, can be more difficult than when using broader-spectrum synthetic insecticides.

The District's control efforts begin with developing an inventory of potential larval breeding habitats including records of larval production. The District has identified and mapped over 65,000 potential and known larval breeding sites. District staff record the number and kind of larvae found along with treatment information for every site, which allow them to target larval control treatments to the most productive breeding sites. The District updates section maps to reflect changes in breeding sites. The District's 1994 self-assessment identified a goal of updating all maps every five years. In 1994, over 98 percent of the maps were less than five years old.<sup>10</sup> Staff have continued to update recently treated breeding site maps annually. Breeding site maps for rural areas not receiving larval insecticide treatments have not been routinely updated.<sup>11</sup>

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<sup>8</sup> Interagency Panel on MMCD Effectiveness, "Summary and Status," March 19, 1996.

<sup>9</sup> Metropolitan Mosquito Control District, *Self-Assessment*: 13, 14, 19, 22.

<sup>10</sup> Metropolitan Mosquito Control District, *Self-Assessment*: 13-14.

<sup>11</sup> The District is changing to a new mapping system with a goal of entering all of the larval breeding sites in Priority Area 1 into the new system by March 1, 1999.

## Material Efficacy

In its public relations materials, MMCD states that it applies insecticides to approximately 15,000 acres of the worst mosquito larval breeding areas in the District after each significant summer rain. The District claims that these treatments prevent a minimum of three billion mosquito larvae from emerging as adults and result in tolerable levels of adult mosquitoes in most parts of the metropolitan area.<sup>12</sup> MMCD used the results of larval insecticide efficacy testing to form the basis for this statement. The District monitors larval mosquito populations to measure the results of treatments in some breeding sites. We found that:

- **Most of the insecticides used by the District to kill mosquito larvae have not met the District's goal of killing 95 percent of the larvae.**

We examined the District's efficacy data for *Bti* granules and methoprene pellets and briquets used to kill floodwater and cattail mosquito larvae. Only methoprene pellets, when used to kill cattail mosquitoes, consistently met the District's goal of killing at least 95 percent of the larvae.

MMCD measures the effectiveness of methoprene briquets and pellets for killing cattail mosquito larvae using "emergence cages," netted structures covering approximately one square meter of area in a breeding site. MMCD places 6 emergence cages at each of 24 test sites: 8 sites treated with methoprene briquets, 8 treated with methoprene pellets, and 8 untreated or control sites. Staff vacuum adult mosquitoes from the cages twice a week from early June to early August. MMCD compares the average adult emergence counts from the two sets of treated sites with the average number from the untreated sites to determine the effectiveness of methoprene briquets and pellets at inhibiting emergence. We found that:

- **Methoprene briquets and pellets reduced the number of cattail mosquitoes emerging from treated sites by at least 92 percent in 1995 and 1996.**

In 1995 and 1996, the two years of data that we reviewed, MMCD determined that breeding sites treated with methoprene pellets had a 99 percent reduction in mosquito emergence compared with untreated sites.<sup>13</sup> Sites treated with methoprene briquets had 92 percent and 96 percent reductions in mosquito emergence for 1995 and 1996, respectively, compared with untreated sites.

MMCD measures the efficacy of *Bti* granules by comparing mosquito larvae counts from breeding sites before *Bti* treatments with counts taken 24 to 48 hours after treatment at randomly selected sites treated by helicopter. We found that:

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**Only methoprene pellets used to kill cattail mosquito larvae consistently met the District's goal.**

<sup>12</sup> Metropolitan Mosquito Control District, "Fact Sheet: Program Effectiveness," July 18, 1996.

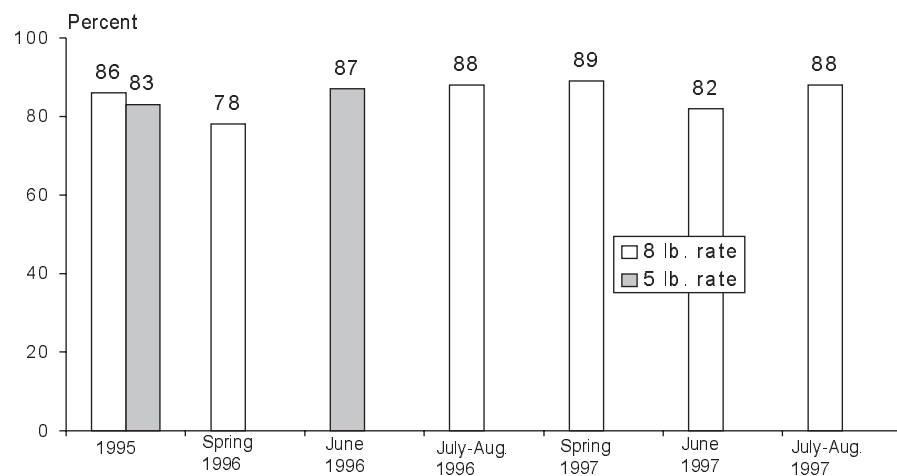
<sup>13</sup> The District did not conduct material efficacy tests for cattail mosquitoes in 1997 or 1998 because the emergence cages were being used to test an experimental product.

- The average control achieved with *Bti* granules, the insecticide that accounted for most of the larval breeding acres treated, ranged from 78 to 89 percent in recent years.

We reviewed MMCD's *Bti* efficacy data for 1995 through 1997. Since we obtained similar figures as those reported by the District in most cases, we concluded that MMCD's calculations were correct.<sup>14</sup> Figure 4.1 summarizes the percent control achieved by the District with *Bti* granules during this time. During these years, applications of *Bti* granules accounted for between 85 and 90 percent of acres treated for larval control.

***Bti* usually has killed between 78 and 89 percent of mosquito larvae.**

**Figure 4.1: Average Percent Control of Mosquito Larvae with *Bti* Granules, 1995-97**



NOTE: The Metropolitan Mosquito Control District applies *Bti* granules at two different rates: 5 pounds and 8 pounds per acre. Factors such as time of the year, water quality, temperature, and larval density will affect the effectiveness of *Bti* and the application rate the District uses.

SOURCE: Metropolitan Mosquito Control District.

In 1995, MMCD used *Bti* at 5 pounds and 8 pounds per acre rates and achieved control of 83 and 86 percent respectively. In 1996, MMCD applied *Bti* at different rates at different times during the year. MMCD used *Bti* at the 5 pound rate during the summer (June) that provided 87 percent control. In spring (through May) and late summer (July and August), MMCD applied *Bti* at the 8 pound rate and reported control of 78 and 88 percent, respectively. The District said it tested additional sites in the spring of 1996 because of low control rates obtained initially, and in the subsequent counts found control of 90 percent.<sup>15</sup>

<sup>14</sup> In two instances we were unable to replicate MMCD's reported efficacy results for *Bti* using the District's data. Our calculation of the percent control achieved with *Bti* in the spring of 1996 was 73 percent compared with 78 percent reported by MMCD and our calculation for early summer (June) 1997 was 74 percent compared with 82 percent reported by MMCD.

<sup>15</sup> Metropolitan Mosquito Control District, *1996 Operational Review and Plans for 1997*, March 1997: 36.

MMCD also measured the efficacy of *Bti* for three periods in 1997 at sites treated with the 8 pounds per acre rate. MMCD reported an overall control rate of 88 percent. A different brand of *Bti* granules, being tested by MMCD in 1997, provided control of 94 percent when applied by air at the 8 pound rate.

MMCD measures the effectiveness of methoprene briquets and pellets for killing floodwater mosquitoes by comparing the number of larvae in a sample that emerge as adults from treated and untreated sites. Using a specific formula, District staff have calculated an “emergence inhibition rate” for each treated site.<sup>16</sup> To get a district-wide average, MMCD has calculated the average of the site-specific “emergence inhibition rates.” Using this method, the District has given each site an equal consideration or weight. If the District used average pre- and post-treatment counts to calculate the district-wide emergence inhibition rate, it would give greater weight to observations from sites with higher pre-treatment counts. Obviously, the two methods will give different results. When asked to comment on these two methods, a University of Minnesota entomologist responded that there may be no right way to evaluate control across sites. However,

- **We have other concerns about how the District has calculated and presented information on the effectiveness of methoprene products used to control floodwater mosquitoes.**

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**The District needs to review and document how it measures the effectiveness of methoprene products used to kill floodwater mosquitoes.**

We noted the following concerns. First, we were not able to replicate MMCD’s control figures for 1995 and 1996 using the District’s data. According to District staff, a former staff person had completed the 1995 and 1996 “emergence inhibition rates.” District staff were unable to give us information on how those calculations were made in 1995 and 1996. In 1997, MMCD changed the way it calculated the effectiveness of methoprene pellets used to kill floodwater mosquitoes by restricting analysis to sites that were treated using seeder applicators and for which samples were collected between 6 and 30 days after application.<sup>17</sup>

Second, in 1997 the District made some changes to its data that may not be appropriate. In 1997, when the “emergence inhibition rate” for a site was negative, the District changed the rate to a positive number. In *Bti* efficacy calculations, the District changes negative numbers to zero indicating no effect. Changing negative rates to positive ones indicates a positive effect when none was shown and increases the overall control rate calculated. District staff have noted that these were typographical errors. While the use of two positive values did not change the results in this instance, we have raised the issue because of our concerns about the methods and quality controls used to calculate material efficacy.

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<sup>16</sup> The formula, developed by Dr. Mir Mulla, is: Percent reduction (or emergence inhibition) =  $100 - (C1/T1 \times T2/C2) 100$ . Where C1 = average number of larvae in pre-treatment control (untreated) sites; T1 = average number of larvae in pre-treatment treated sites; C2 = average number of larvae in post-treatment control (untreated) sites; and T2 = average number of larvae in post-treatment treated sites.

<sup>17</sup> The time restriction reflects the manner in which methoprene pellets work. According to MMCD, pellets begin to provide control six days following treatment. Since pellets are a 30-day control material, the sampling time frame was restricted to within 30 days of treatment.

Third, the information the District reported in its *1997 Operational Review and Plans for 1998* was not correct. District staff supplied us with corrected information as shown in Table 4.1, noting that the draft data were not changed before the report was released. Finally, in 1996 and 1997, the District's evaluation of control achieved with methoprene briquets was based on a sample of only five sites. The District acknowledged in its 1997 operational review that these efficacy tests were based on a small sample size. We recommend that:

- **The District should clarify how it measures the effectiveness of methoprene products used to kill floodwater mosquito larvae and institute data management procedures outlining the methods.**

**Table 4.1: Average Percent Control with Methoprene for Floodwater Mosquitoes Reported by the Metropolitan Mosquito Control District, 1995-97**

Percent Control Reported	1995	1996	1997	1997 MMCD Corrected
Briquets	82% (N=106)	55% (N=5)	81% (N=5)	NA NA
Pellets	88% (N=63)	80% (N=66)	77% (N=69)	73% (N=39)

NOTE: NA = Additional data were not available.

SOURCES: Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*; Electronic-mail message from Mark Smith, Technician, October 26, 1998.

**The effectiveness of methoprene products used to kill floodwater mosquitoes has been inconsistent.**

Annual fluctuations in the effectiveness of methoprene products to kill floodwater mosquitoes are evident in Table 4.1. For instance, average control achieved by methoprene briquets was 82 percent in 1995 and 55 percent in 1996. The District reported that the average control achieved was negatively affected by treating only the more difficult to reach breeding sites.<sup>18</sup> In addition, the average control achieved with methoprene pellets as reported by MMCD has declined from 88 percent in 1995 to 73 percent in 1997. Sometimes MMCD staff have attributed these changes to weather conditions, other times the reason for changes has not been known. We recommend that:

- **The Metropolitan Mosquito Control District should critically examine its use of methoprene briquets and pellets to control floodwater mosquito larvae considering both efficacy and cost factors.**

<sup>18</sup> Metropolitan Mosquito Control District, *1996 Operational Review*: 35.

In its 1996 operational review, the District noted that it reduced the use of methoprene briquets because of high costs and “inconsistent effectiveness.”<sup>19</sup> The review also stated that “Performance of methoprene products must improve if MMCD is to achieve the target rate of at least 95 percent control in treated mosquito breeding sites.”<sup>20</sup> The District’s 1997 operational review did not express any concerns about the effectiveness of methoprene products. In 1998, the District increased the number of sites sampled to test the effectiveness of methoprene pellets and it sampled sites treated with 90-day briquets (a product not used in prior years), however only five sites could be analyzed for 150-day briquets.<sup>21</sup> If the District continues to use methoprene briquets, we suggest that the number of sample sites used to calculate material efficacy be increased. According to its 1999 budget, the District plans to improve its measurement of effectiveness by further increasing the number of applications that are evaluated.

In addition to material efficacy testing, the District uses an outside laboratory to test the active ingredient content of methoprene products before they are accepted. MMCD has a supplier certification program that requires in-house testing of products before a vendor’s bid will be considered. It also tests different product formulations and new products that might have higher control rates.

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**In the early 1990s, the District studied the insecticides used to kill adult mosquitoes.**

The District sponsored a number of in-house studies in the early 1990s on the insecticides it used to kill adult mosquitoes. This research documented that the control achieved by permethrin, which is applied to foliage and kills mosquitoes when they land on the treated foliage, was significant for up to five days.<sup>22</sup> Other research focused on application methods for adult control materials and concluded that a combination of permethrin and resmethrin cold fogging treatments was most effective at reducing mosquito counts as measured with sweep net collections. This study also found that resmethrin alone showed no reduction in mosquito numbers at one day post-treatment.<sup>23</sup> Finally, a 1992 park study was designed to measure the effect of permethrin treatments (applied with a backpack mister) in four high-use parks. The study found that although there was no statistical significance in the number of adult mosquitoes between treated and untreated parks, fewer mosquitoes were measured in treated parks.<sup>24</sup> We also found that:

- **In 1996, the District conducted efficacy tests on the insecticides used to kill adult mosquitoes and estimated that the average adult mosquito reduction in treated sites was about 57 percent.**

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<sup>19</sup> *Ibid.*, 21.

<sup>20</sup> *Ibid.*, 35.

<sup>21</sup> We were unable to review the 1998 methoprene efficacy data because they were not available until late in the project.

<sup>22</sup> Merry L. Holliday-Hanson, Chris E. Boxmeyer, Susan L. Palchick, “Residual Effects of Punt Applied as a Barrier Treatment Against *Aedes Vexans* in Wooded Areas in Minnesota,” unpublished, Proceedings from 1992 California Mosquito Vector Control Association, 1992.

<sup>23</sup> Metropolitan Mosquito Control District, “1992 Mosquito Adulticide Test,” unpublished, 1993: 1, 4.

<sup>24</sup> Chris Boxmeyer and Susan Palchick, “Comparison of Evening Adult Mosquito Numbers in Treated v. Untreated Parks Using Whole-Person Bag Samplers and CO<sub>2</sub> Traps,” unpublished, undated.



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**We have some concerns about using 1998 pre- and post-treatment adult mosquito counts to measure effectiveness.**

In 1996, the District sponsored an evaluation of resmethrin and permethrin in 20 treated sites in Anoka, Dakota, Hennepin, and Washington counties. While some sites showed a reduction of over 90 percent, other sites showed zero reduction in the adult mosquito population.

In an effort to evaluate the effectiveness of insecticides used to kill adult mosquitoes, the District revised its adult mosquito treatment field form to provide for the collection of pre- and post-treatment adult population counts in 1998. Comparison of the pre- and post-treatment adult mosquito counts showed a 90 percent reduction in the number of adult mosquitoes following treatment. However, these data were not collected as part of a designed, supervised research study. One of our concerns with the 1998 pre- and post-treatment data is that the majority of counts used the “slap test” sampling method, a subjective method of obtaining adult mosquito counts.<sup>25</sup> The 1996 study used CO<sub>2</sub> traps to sample adult mosquito populations. According to the District, “this sampling method provides . . . a more standardized measure [of adult mosquito populations] than the widely used slap count.”<sup>26</sup> Other concerns with using the 1998 pre- and post-treatment data as a measure of effectiveness include that apparently there were no written procedures on how to select a treatment to sample or the timing and location of the post-treatment collections and technical service staff did not supervise the collection process. We recommend that:

- **The District should assign a high priority to measuring the effectiveness of adult insecticides in scientifically designed and supervised field studies in 1999 and use the results of these studies to evaluate the proper role for adult mosquito treatments in its mosquito control efforts.**

Based on past District-sponsored studies, the effectiveness of resmethrin and permethrin in killing adult mosquitoes does not compare favorably with the effectiveness achieved with some larval insecticides. While permethrin appears to kill mosquitoes for up to five days, the effectiveness of resmethrin at controlling mosquitoes following immediate exposure has been called into question by the District’s own research. Finally, the District has not conducted any research on the effects of resmethrin and permethrin on other insects not targeted for control, such as bees.<sup>27</sup>

## **Citizen Tolerance and Expectations**

Over the years, MMCD has conducted studies on citizen tolerance and expectations using public opinion surveys, focus groups, and field sampling of

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<sup>25</sup> Field staff do slap counts by standing in a location and counting the mosquitoes that land on them.

<sup>26</sup> Metropolitan Mosquito Control District, *1996 Operation Review*: 37.

<sup>27</sup> Some reviews on the nontarget impact of these adult insecticides have been conducted. As noted in Chapter 2, the World Health Organization reviewed scientific literature and concluded that resmethrin and permethrin were unlikely to attain levels of environmental significance when used under recommended conditions.

adult mosquito populations.<sup>28</sup> Generally, these studies have found that:

1. When three or more mosquitoes approach a person in five minutes, most people will use repellent or go indoors. When more than 11 mosquitoes attack a person in five minutes, most people will go indoors even if using a repellent.
2. People vary in their tolerances of three or more mosquitoes in five minutes, but all people were bothered when more than 11 mosquitoes attacked in five minutes.

Based on these data, the District identified the level at which mosquito populations interfere with people's enjoyment of the outdoors as two mosquitoes approaching a person within five minutes. These results were used to develop the District's threshold for treatment of adult mosquitoes—two mosquitoes in two minutes for sweep net collections or slap counts.

## Adult Collection Data

Adult mosquito populations are the ultimate measure of MMCD mosquito control efforts. Entomologists we interviewed seem to agree that it is also the most difficult factor to measure because it involves relating larval control to regional adult populations and the number of mosquitoes in someone's backyard. An additional difficulty involves measuring citizen expectations and making judgments about something that did not happen. MMCD conducted several adult mosquito population studies in the early 1990s in an attempt to document effectiveness of its operations. We found that:

- **The results of District-sponsored studies on the overall effectiveness of mosquito control efforts generally have been inconclusive.**

In 1993, the District sponsored two studies that used data on adult mosquito populations to measure the overall effectiveness of its mosquito control efforts. One study compared data from light traps located inside and outside the District. Another study compared data on mosquito populations in the Twin Cities area from 1939, before the District existed, with data from 1963 and 1993. The results of both of these studies were inconclusive with some observations showing lower mosquito populations outside the District or before the District was created. These studies illustrate the difficulty of designing a field study where environmental factors (such as mosquito breeding habitat and weather) vary among multiple locations and over time.

The Interagency Panel on MMCD Effectiveness recommended that MMCD measure effectiveness in two areas: 1) breeding acres treated and efficacy of materials used, and 2) perceptions of effectiveness in citizens' backyards. In

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<sup>28</sup> Nancy R. Read, Jay R. Rooker, and Joseph P. Gathman, "Public Perception of Mosquito Annoyance Measured by a Survey and Simultaneous Mosquito Sampling," *Journal of the American Mosquito Control Association*, 10(1), 1994: 79-87; Nancy R. Read, "Public Perceptions and Tolerance of Mosquitoes and Biting Gnats and Willingness to Pay for Reduced Populations: Results of a Focus Group Study Conducted August 1995," unpublished, January 1996.

addition to sponsoring focus groups, the panel's work resulted in a 1995 computer simulation that used GIS data to analyze a rainfall event, breeding site treatments, and the resulting adult mosquito populations. MMCD staff have not continued to use this technique to study effectiveness because of limited staff resources.

While the District routinely collects adult mosquito population data using light traps and sweep net collections, it has not used these data to demonstrate its overall effectiveness because many other factors can influence the distribution and presence of mosquitoes. Instead, District staff have relied on weekly adult mosquito population data to identify breeding sites where larval control was needed and areas that may benefit from adult mosquito treatments. Table 4.2 illustrates how adult mosquitoes populations varied in the Twin Cities area in 1997.

**Table 4.2: Light Trap Mosquito Collection Totals, 1997**

	St. Paul	Lake Elmo	Lino Lakes	Elm Creek Park	Carlos Avery	Season Total	Average per Night	Percent Female
Selected Mosquito Species:								
Floodwater	242	5,811	10,315	10,252	23,153	49,773	72.66	54.85%
Tree hole	1	20	1	3	0	25	0.04	0.03
Cattail	5	49	795	833	31,517	33,199	48.47	36.58
All Species:								
Female Total	273	6,622	12,108	12,879	58,846	90,746	132.48	
Male Total	193	1,499	12,788	3,823	5,234	23,537	34.36	
Grand Total	466	8,121	24,896	16,702	64,080	114,283	166.84	

SOURCE: Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*: 27.

Compared with other states we contacted, MMCD uses similar techniques to monitor the effectiveness of its mosquito control program. Most of the states we contacted rely on pre- and post-treatment sampling, light trap collections, and citizen complaints to monitor the effectiveness of mosquito control activities.

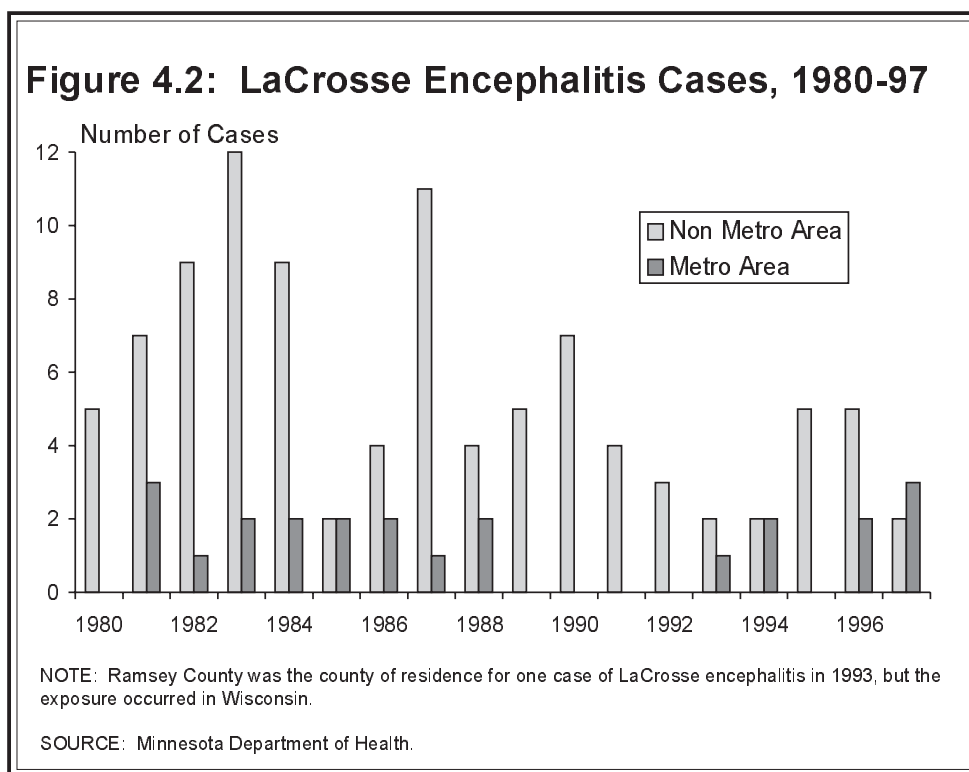
## INSECT-BORNE DISEASE PREVENTION

The District formally began LaCrosse encephalitis (LAC) prevention activities in 1987. Its goal is to effectively monitor and control disease carrying mosquitoes to protect human health.<sup>29</sup> Control efforts focus on the tree hole mosquito, a potential carrier for LAC. MMCD uses the number of LAC cases to demonstrate effectiveness. According to Minnesota Department of Health data:

<sup>29</sup> Metropolitan Mosquito Control District, *Self-Assessment*: 9.

- **The number of reported LaCrosse encephalitis cases in the Twin Cities metropolitan area has declined since 1987.**
- **The incidence of LaCrosse encephalitis has been lower in metropolitan counties since 1985 compared with counties in southeastern Minnesota.**

Figure 4.2 illustrates that there were fewer reported cases of LaCrosse encephalitis in the Twin Cities area after 1987 than before. Prior to 1987, the metropolitan area had averaged between two and three cases of LaCrosse encephalitis a year. No cases of LaCrosse encephalitis were reported in the Twin Cities area from 1989 through 1992 and in 1995, two were reported in both 1994 and 1996, and three were reported in 1997.<sup>30</sup> Table 4.3 shows that metropolitan area counties had much lower LaCrosse encephalitis incident rates than other Minnesota counties.



Public health and MMCD staff caution that while the occurrence of LAC could be a reasonable measure of effectiveness, it has limitations. The occurrence of LAC may involve factors that MMCD does not have any control over, such as the diagnosis and reporting of the disease. LAC is an under diagnosed disease, whose spectrum of illness can range from asymptomatic to life threatening. In regions where LaCrosse encephalitis occurs, there are probably more cases occurring than are reported.

<sup>30</sup> Ramsey County was the county of residence for the one metropolitan case in 1993, but the exposure occurred in Wisconsin.

**Table 4.3: LaCrosse Encephalitis Incidence Rates by County, 1985-96**

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
<u>Metro Counties</u>													
Anoka	--	--	--	--	--	--	--	--	--	--	--	--	1.1
Dakota	1.1	1.0	--	1.8	--	--	--	--	--	--	--	--	--
Hennepin	0.3	--	0.3	--	--	--	--	--	--	0.7	--	0.7	0.7
Ramsey	--	--	--	--	--	--	--	--	0.7	--	--	--	--
Washington	--	1.8	--	--	--	--	--	--	--	--	--	--	--
<u>Non Metro Counties</u>													
Blue Earth	4.0	--	--	--	--	--	--	--	--	--	--	--	--
Dodge	--	--	15.0	--	--	--	--	--	--	--	--	--	--
Fillmore	--	12.3	37.5	--	--	--	15.9	--	--	--	--	--	--
Goodhue	--	--	--	--	11.3	24.9	--	15.9	--	--	--	7.8	--
Houston	14.1	--	13.8	13.2	16.6	--	17.4	17.2	34.4	34.1	51.1	68.1	16.9
Olmsted	--	7.4	2.4	4.8	--	--	--	--	--	--	--	--	--
Wabasha	--	--	13.2	--	--	16.2	16.2	--	--	--	15.8	--	--
Winona	--	--	19.1	4.7	--	20.4	6.8	--	--	--	6.6	--	--
Wright	--	--	--	--	--	--	--	--	--	--	--	--	3.6

NOTE: Incidence rate = number of cases per 100,000 person-years of risk in children less than 20 years old.

SOURCE: Minnesota Department of Public Health.

## BLACK FLY CONTROL

MMCD performs black fly material efficacy tests at treatment sites on large rivers as a condition of its Department of Natural Resources permit. MMCD also measures the effectiveness of its black fly program by reporting the reduction of average adult black fly counts over the years. The District does not do material efficacy tests after treatments on small streams.

### Material Efficacy

**The District strives to achieve 80 percent control of black fly larvae.**

While MMCD does not have a written target efficacy rate for the black fly program, program staff indicated that they hope to achieve at least 80 percent control. The data provided by MMCD to the DNR in its permit applications (see Table 4.4) show that:

- **From 1995 to 1997, the average mortality achieved on each river was at least 80 percent, except for the Crow River in 1997.**

MMCD attributed the poor performance on the Crow River to one treatment with a very low efficacy rate (22 percent) that may have been due to the low discharge

**Table 4.4: Average Mortality of Black Fly Treatments by River, 1995-97**

River	1995	1996	1997
Crow	100% (N=4)	99% (N=3)	69% (N=3)
Minnesota	87 (N=15)	94 (N=10)	96 (N=23)
Mississippi	87 (N=12)	94 (N=9)	97 (N=6)
Rum	98 (N=10)	80 (N=13)	81 (N=17)

SOURCE: Metropolitan Mosquito Control District.

**Average mortality of black fly treatments for 1995-97 was 80 percent or higher.**

in the Crow at the time of application.<sup>31</sup> Table 4.4 also shows that over half of the average mortality figures by river for 1995-97 exceeded 90 percent. We also noted that:

- **In 1997, the percentage of treatments achieving a mortality rate of 80 percent or more varied by river— 53 percent of the tested treatments achieved that rate on the Rum and 67 percent on the Crow rivers, compared with 96 percent on the Minnesota and 100 percent on the Mississippi rivers.**

Table 4.5 shows that overall, over 90 percent of the samples from all large rivers achieved an efficacy rate of at least 80 percent in 1995, but that figure dropped to 80 percent in 1997. Much of this decline was explained by the performance of *Bti* liquid in the Rum River. A possible explanation suggested by MMCD was that there may have been a large black fly population upstream (outside the District) from the northern most treatment site on the Rum River.

## Adult Collection Data

MMCD uses adult black fly counts from 1984 to present to show that its program has had an effect on the black fly population in the metropolitan area. As Table 4.6 shows, the counts revealed a drop in the annual average number of black flies captured from 17.95 in 1984 to 2.91 in 1997.

<sup>31</sup> The number of treatments sampled varies by river and by year. For instance in 1997, all treatments on the Crow River were sampled, while about half of the treatments on the Mississippi River were sampled. MMCD's permit from DNR requires efficacy sampling for all river treatments, but DNR staff are not concerned that not all treatments are sampled. DNR staff monitoring the black fly program told us that they rely more on site-specific efficacy data than average efficacy by river when reviewing the program's performance.



**Table 4.5: Percentage of Black Fly Treatments with Efficacy of 80 Percent or More, 1995-97**

<u>River</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Crow	100% (N=4)	100% (N=3)	67% (N=3)
Minnesota	87 (N=15)	100 (N=10)	96 (N=23)
Mississippi	92 (N=12)	89 (N=9)	100 (N=6)
Rum	100 (N=10)	69 (N=13)	53 (N=17)
Overall	93 (N=41)	86 (N=35)	80 (N=49)

SOURCE: Metropolitan Mosquito Control District.

MMCD and DNR staff have expressed some concerns with the method used to monitor one species of black fly, *S. venustum*, primarily because of the time of day the monitoring is done.<sup>32</sup> DNR's concerns extend to the monitoring method more broadly, in part because the method was developed for sampling mosquitoes, not black flies. The MMCD consultant working with the black fly program believes that the large drop in the adult black fly counts that has been observed since the start of the program clearly shows that the program is having an effect on the black fly population. The DNR staff person assigned to monitor the black fly program is convinced MMCD is killing black flies because of the efficacy rates the District achieves, but he does not rely on adult black fly counts to judge effectiveness of the black fly program.

## SUMMARY

Adult mosquito populations are the ultimate measure of MMCD's mosquito control efforts. However, it is also the most difficult factor to measure because it involves relating mosquito larval control to regional adult populations, while accounting for variables such as number of mosquitoes produced from breeding sites, weather, flight distance of adult mosquitoes, and citizen expectations. District-sponsored studies on the overall effectiveness of adult mosquito control

<sup>32</sup> Black fly samples are typically taken in the morning, probably before *S. venustum* become very active. MMCD is doing research to better understand the time of day when *S. venustum* are active with the goal of developing a sampling method that will effectively monitor the population without having to use human collectors.

**Table 4.6: Annual Average Number of Adult Black Flies Collected, 1984-97**

	<u>Year</u>	<u>All Species<sup>a</sup></u>
<b>The District uses the number of adult black flies collected to show that control efforts are having an effect.</b>	1984	17.95
	1985	14.56
	1986	11.88
	1987	6.53
	1988	1.60
	1989	6.16
	1990	6.02
	1991	2.59
	1992	2.63
	1993	3.00
	1994	2.41
	1995	1.77
	1996	0.64
1997	2.91	

<sup>a</sup>All species includes *S. luggeri*, *S. meridionale*, *S. johannseni*, *S. vittatum*, and *S. venustum*.

SOURCE: Metropolitan Mosquito Control District, *1997 Black Fly Program Report* submitted to Minnesota Department of Natural Resources, February 1998: 18.

have been inconclusive. Instead, the District has used the effectiveness of larval insecticides it applies as a measure of effectiveness.

The District's goal is to kill 95 percent of mosquito larvae or adults when it uses insecticides. We examined the District's material efficacy data for 1995 through 1997 and found that most of the insecticides used by the District to kill mosquito larvae did not meet the 95 percent goal. Methoprene briquets and pellets used to kill cattail mosquito larvae have performed the best (92 to 99 percent control). *Bti* granules, which account for about 90 percent of breeding site acres treated, averaged 78 to 89 percent control in 1995-97. We were not able to replicate MMCD's control figures for methoprene products used to kill floodwater mosquitoes. We recommend that the District reevaluate its use of methoprene briquets and pellets to control floodwater mosquito larvae, looking at both efficacy and cost factors.

The District tested the effectiveness of resmethrin and permethrin used to kill adult mosquitoes in 1996, when it estimated that an average of 57 percent of adult mosquitoes were killed in treated sites. Based on the results of District-sponsored studies in the early 1990s, the effectiveness of these adult insecticides appears to be questionable. In 1998, the District collected pre- and post-treatment adult mosquito counts. However, we have some concerns about using these data to evaluate the effectiveness of adult insecticides. We recommend that the District evaluate the effectiveness of resmethrin and permethrin in scientifically designed and supervised field studies in 1999 and reexamine the role of adult mosquito treatments based on the results of its analysis.

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# Public Accountability and Governance

## CHAPTER 5

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**T**he Metropolitan Mosquito Control District (MMCD) is governed by a commission composed of county commissioners. Although the District serves the Twin Cities area, it is not a metropolitan agency and does not have a formal relationship with the Metropolitan Council. Given its unique position between local and regional units of government, some legislators have expressed concern about whether the District is subject to close government oversight. Critics have also expressed concern about whether the public is adequately informed of the District's mosquito control activities. We asked the following questions:

- **What state laws govern the Metropolitan Mosquito Control District's operation?**
- **Are changes needed to make the District more accountable to the Legislature and the public?**
- **How are mosquito control services organized and provided in other states? How does MMCD's governance structure compare with mosquito control districts in other states?**
- **How well does MMCD inform the public of its mosquito control activities?**

To answer these questions, we examined laws that apply to the Commission and the District. We reviewed the District's enabling legislation and laws about open meetings, ethics in government, data practices, purchasing, budgeting and accounting, and financial reporting. We examined the District's administrative policy manual, reviewed minutes of Commission meetings, attended Commission meetings, and interviewed commissioners and District staff. We also conducted telephone interviews with representatives from other states with mosquito control districts and accessed their Internet sites.

Overall we found that the Metropolitan Mosquito Control Commission generally has complied with state laws designed to provide for public accountability. We do not recommend that the governance structure of the District be changed at this time, but we suggest that the Legislature consider reducing the size and changing the composition of the Commission.

The District currently provides information about its activities to the public in a number of ways, such as a telephone information line, web site, and individual telephone calls to some people. During 1998, the District published an advertisement in newspapers as part of a “negotiated agreement” with several legislators. In addition, the District continued to post notices on public land treated with adult insecticides, as it has done since 1995. However, as a result of the negotiated agreement, the notices remained posted for five days. We recommend that the District should continue its current public notification efforts, including those that were part of the “negotiated agreement” in 1998.

## PUBLIC ACCOUNTABILITY

Minnesota laws define the Metropolitan Mosquito Control Commission (MMCC) as a “local unit of government” and as a “metropolitan special taxing district,” for property taxation purposes.<sup>1</sup> While state laws authorize the creation of most special taxing districts, there is no single statutory definition. A special taxing district is generally considered a unit of government authorized and created by the Legislature to perform specific duties or provide specific services to the taxpayers. The Minnesota House of Representatives Research Department has defined a special taxing district as, “a political subdivision of the state of Minnesota which (1) has the legal authority to levy property taxes and (2) is not a county, city, township, or school district.”<sup>2</sup>

There are two types of special taxing districts. First, the Legislature can directly create specific special taxing districts, such as the Metropolitan Council and the Suburban Hennepin Park District. The Metropolitan Mosquito Control Commission fits into this category. Second, Minnesota laws permit governmental units to establish special taxing districts for specific purposes, such as housing and redevelopment and watershed control.

As far as we can determine,

- **The Metropolitan Mosquito Control Commission generally has complied with most state laws designed to provide public accountability.**

Based on our analysis, summarized in Figure 5.1, the Commission and the District have complied with relevant enabling legislation, the state’s Open Meeting and Ethics in Government acts, and purchasing, tax levy, budgeting and accounting, and auditing controls contained in state law.

The Commission’s enabling legislation (*Minn. Stat.* §473.703) provides for the appointment of members, stipulates that vacancies shall be filled in the same manner as initial appointments, and requires the Commission to hold a January

<sup>1</sup> *Minn. Stat.* §§473.121, subds. 5a and 6, §275.065, subd. 3, para. (i), and §275.066 (16).

<sup>2</sup> Minnesota House of Representatives Research Department, *Special Taxing Districts*, November 1993: 3.

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**MMCD is a special taxing district with authority to levy property taxes.**

### Figure 5.1: Laws Governing the Metropolitan Mosquito Control Commission and District

	<u>State Law</u>	<u>Requirements</u>
Governing Board	<i>Minn. Stat.</i> §473.703	Metropolitan mosquito control commissioners appointed annually from participating county boards.
Expense Reimbursement for Commission Members	<i>Minn. Stat.</i> §473.714	Commissioners with an annual public salary of \$25,000 or more are reimbursed for travel expenses only.
Open Meeting Act	<i>Minn. Stat.</i> §471.705	Meetings are open to the public. Advance notice is provided. Votes and actions are recorded.
Ethics in Government Act	<i>Minn. Stat.</i> Ch. 10	Commissioners file statements of economic interest in their respective counties and must disclose conflicts of interest.
Data Practices Act	<i>Minn. Stat.</i> Ch. 13	Data are generally public, with some exceptions.
Purchasing	<i>Minn. Stat.</i> §471.345	Uniform Municipal Contracting Law sets limits for sealed bids on materials, supplies, equipment.
Property Tax Levy	<i>Minn. Stat.</i> §275	A notice of intent to adopt a budget and property tax levy is published. "Truth in taxation" hearings are held.
Budget and Accounting Controls	<i>Minn. Stat.</i> §473.711	Property tax levy is certified to the Commissioner of Revenue.
Financial Reporting	<i>Minn. Stat.</i> §473.704, subd. 19	A financial report to the Legislature is required in even-numbered years.
Audits	<i>Minn. Stat.</i> §473.703, subd. 10	Legislative Auditor conducts financial review "once each year or as often as . . . funds and personnel permit."

SOURCES: Minnesota Statutes as cited above; Metropolitan Mosquito Control District, *Administrative Manual*; Mr. Bill Caesar, District Business Director, Interview, June 25, 1998.

organizational meeting at which it will select the officers. The Commission's meetings are open to the public. Meeting notices are posted on the bulletin board at the District's office. The Commission should also post meeting notices on its Internet web site.

However, based on our analysis of state laws and Commission procedures, we found that:

- **In 1996, the Metropolitan Mosquito Control Commission did not submit a required financial report to the Legislature.**

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**A 1998 advisory opinion from the Commissioner of Administration said that District data on citizens are public information.**

Minnesota law requires the Commission, by December 15 of each even-numbered year, to prepare and submit to the Legislature a financial report.<sup>3</sup> According to District staff, the Commission did not file a financial report in 1996 because the Metropolitan Council did not file such a report, and state law directs the Commission to follow the reporting format used by the Council. The Commission has submitted its 1998 financial report to the Legislature. We also found that:

- **In the past, the District has not always classified as “public” information on citizens who request or refuse service, as required by the Data Practices Act.**

In October 1998, the Commissioner of Administration issued an advisory opinion concerning data maintained by the District. The opinion stated that:

the following data are classified as public: individuals’ names, addresses, telephone numbers and specific requests regarding services provided by the . . . District. If under limited circumstances, the MMCD has specific reason to conclude that dissemination of some of those data would be likely to substantially jeopardize information, possessions, individuals or property, then those specific data are private or nonpublic . . .<sup>4</sup>

We recommend that:

- **In the future, the Commission should submit biennial financial reports to the Legislature and classify as “public” information on citizens who request or refuse service, as required by state law.**

The Metropolitan Mosquito Control Commission’s enabling legislation requires the Office of the Legislative Auditor to conduct financial audits of the Commission’s accounts “once each year or as often as . . . funds and personnel permit.”<sup>5</sup> Over the past several years, critics of MMCD have raised a number of issues which have been addressed in the District’s financial audit reviews. First, a former MMCD director developed the 150 day timed-release methoprene briquet used by the District to kill mosquito larvae. The District received two patents (issued on June 2, 1987 and March 22, 1988) for the process used to manufacture the briquets. After fees to maintain the patents are deducted from the royalties, 25 percent of royalty payments are paid to the former MMCD director. In 1997, the District collected \$35,038 in royalties and paid \$7,829 to the former director.<sup>6</sup>

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<sup>3</sup> *Minn. Stat.* §473.704, subd. 19. The financial report is supposed to contain the information required by *Minn. Stat.* §473.1623, subd. 3.

<sup>4</sup> Mr. Donald A. Gemberling, Director of the Information Policy Analysis Division, Minnesota Department of Administration, to Mr. David A. Clark, Attorney at Law, October 20, 1998, memorandum.

<sup>5</sup> *Minn. Stat.* §473.703, subd. 10.

<sup>6</sup> Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, June 1998: 16. According to the District, it does not collect any royalties on products purchased by the District.



Second, concern has been expressed about District investments. The District participates in the Minnesota Association of Governments Investing for Counties (MAGIC) Trust Fund, a professionally managed money market fund. The fund is sponsored by the Minnesota Treasurer's Association and the Association of Minnesota Counties as a financial service primarily for Minnesota counties.<sup>7</sup>

Third, critics have alleged that commissioners benefit from excessive travel and other perks. Review of the District's budget shows that Commission travel expenses have ranged from a high of about \$7,000 in 1995 to about \$2,200 in 1997, or less than one-tenth of one percent of the District's operating budget.<sup>8</sup> A 1992 state law limited per diem reimbursement for commissioners.<sup>9</sup> Consequently, commissioners receive reimbursement for travel expenses but do not receive per diems.

Fourth, critics have charged that MMCD maintained a fleet of trucks that had more vehicles than the number of employees using the trucks. In 1997, the District had a fleet of 178 vehicles: 169 pickup trucks, 6 large trucks, and 3 cars or vans. During the 1997 mosquito control season, the District had employed 181 field staff: 5 group leaders, 27 team leaders, and 149 seasonal staff.<sup>10</sup>

## GOVERNANCE STRUCTURE

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### The Mosquito Control District is governed by a 17-member commission.

MMCD is governed by a 17-member commission composed of county commissioners appointed annually by their respective county boards. The Metropolitan Council does not review the District's budget or approve its spending plans.

In 1992, the Commission created an executive committee made up of the three board officers, plus one member from each county not represented by an officer. The executive committee meets monthly, while the full Commission meets about six times a year to review agenda items, "ratify" decisions of the executive committee, and approve policy for the District.

We examined several alternative governance structures the Legislature could consider to increase oversight of the Metropolitan Mosquito Control District. First, the Legislature could consider placing the District under jurisdiction of the Metropolitan Council. The Metropolitan Council is involved with setting policy,

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<sup>7</sup> *Ibid.*, 7; *Metropolitan Mosquito Control Commission Executive Committee Meeting on January 26, 1994, supporting materials for agenda item 6*. Piper Capital Management Incorporated serves as the fund manager and US Bank serves as custodian of the fund's assets.

<sup>8</sup> Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, for the years 1990-97*.

<sup>9</sup> *Minn. Laws* (1992), ch. 511, art. 2, sec. 38 prevents a Metropolitan Mosquito Control Commission member from being paid a per diem for attending MMCD meetings if the commissioner receives a per diem from the county for the same day. It also limits reimbursement to travel expenses if a commissioner's annual public salary is \$25,000 or more.

<sup>10</sup> Office of the Legislative Auditor, *Metropolitan Mosquito Control District Financial Audit for the Year Ended December 31, 1997*, June 1998: Inventory working papers; Mr. Bill Caesar, District Business Administrator, Interview, St. Paul, Minnesota, October 6, 1998.

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**We examined several alternatives to the current governance structure of the Metropolitan Mosquito Control Commission.**

adopting budgets, and providing other regional services. However, putting MMCD under the jurisdiction of the Metropolitan Council would involve replacing an appointed board of elected officials with a board appointed by the Governor. In addition, mosquito control responsibilities do not appear to be within the scope of the Metropolitan Council's focus on growth and development systems.

Second, MMCD could be placed under the jurisdiction of a state agency, such as the Department of Health or the Department of Agriculture. An advantage of placing mosquito control within an executive agency is that its budget and operations would be reviewed by the Legislature, increasing state oversight. It has been argued that since the public health aspects of mosquito control are a statewide concern, the function could be placed in the Department of Health. However, as discussed in Chapter 1, the District's enabling legislation permits it to kill mosquitoes for both annoyance and disease prevention. Additionally, the risk of LaCrosse encephalitis is more of a regional than a statewide issue. Generally, encephalitis cases have occurred in a relatively small part of the state which includes the Lake Minnetonka area and extends southeast to the hardwood forests along the Mississippi River.

The Department of Agriculture, with its responsibilities for regulating pesticides and dealing with some agricultural pests, might also be a place to house a mosquito control function. Placing mosquito control responsibilities in the Department of Agriculture would require a separation of the department's regulatory and service provision functions. It is unclear whether mosquito control as currently provided fits within the mission of either the department of Health or Agriculture. Neither department currently has the expertise required to assume the District's responsibilities.

Third, the Legislature could remove MMCD's special taxing authority and return it to a local joint powers board. Some legislators have expressed concern that MMCD's special taxing authority undermines public accountability because the budget for mosquito control is not scrutinized by county boards along with other county priorities and budget items. The amount of property taxes levied for mosquito control in each county represents a very small share of total county property tax revenues. In 1996, the MMCD property tax levy represented between 0.7 percent (Scott County) and 1.1 percent (Dakota County) of total county property tax revenues.<sup>11</sup> It is not clear that returning the financial responsibility for the MMCD to individual counties would increase scrutiny of the dollars spent for mosquito control. It could be argued that having the MMCD operate under a separate budget makes it easier to identify and analyze how much citizens have spent for mosquito control.

One of the reasons for giving the Metropolitan Mosquito Control Commission authority to levy property taxes in 1982 was to ensure that the services were consistently provided at a regional level and to provide a more stable and predictable source of revenue. In 1983, legislation provided that "a county may

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<sup>11</sup> Program Evaluation Division analysis using Office of the State Auditor, *Revenues, Expenditures and Debt of Minnesota Counties, December 31, 1996*, September 1998: 14, 16, 18, 20, 30, 32, and 36.

terminate its participation in the district only as provided by other law.” This provision replaced one that allowed a county to withdraw from the District with a 12-month notice. This change gave the Legislature a role in determining participation in the District while making it more difficult for a county to stop participating on its own. We believe that MMCD’s financing should be provided at the regional level. Regional service delivery probably provides more comprehensive mosquito control for the Twin Cities area than could be achieved if only portions of the region participated in the District.

Lacking compelling reasons for a major restructuring of the Metropolitan Mosquito Control Commission and District,

- **We do not recommend major changes to the governance structure of the Metropolitan Mosquito Control District at this time.**

However, we suggest that:

- **The Legislature should consider reducing the size and changing the composition of the Metropolitan Mosquito Control Commission.**

By adding other public representation to the Commission, the Legislature would open the Commission to outside perspectives, help the District respond to outside criticisms, and increase public oversight of the District. Three or four public members could be appointed by the Governor.<sup>12</sup> These members could be selected to represent public park managers, the scientific community, environmental groups, or other expertise. Alternatively, the Legislature could add state agency representatives (such as the commissioner or the commissioner’s designee from the department of Health or Agriculture) to the Commission, along with representatives from the scientific and environmental communities. To prevent the Commission from becoming too large, the number of county commissioners serving on the board could be reduced perhaps to seven members, one from each county participating in the District.

## Technical Advisory Board

State law directs the Metropolitan Mosquito Control Commission to cooperate with various state agencies. It also requires the commissioners of Agriculture, Natural Resources, Transportation, and Health, and the head of the Department of Entomology at the University of Minnesota to act in an advisory capacity to the Commission and the director.<sup>13</sup> In 1981, the director of the District contacted these state agencies and others and invited them to participate in a Technical Advisory Board (TAB). Figure 5.2 lists the agencies, groups, and individuals

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<sup>12</sup> A 1966 Citizens League report recommended that the District be placed under the authority of the Metropolitan Council and, failing that, it recommended that the Commission be reconstituted to include three public members appointed by the Governor, with consideration given to “persons whose business, scientific or professional background can bring desired expertise to the board.” Citizens League, *Report on the Metropolitan Mosquito Control District*, 1966: 6-7.

<sup>13</sup> *Minn. Stat.* §473.716, subd. 2.

**MMCD created a Technical Advisory Board to obtain advice from other public agencies.**

### **Figure 5.2: Composition of the Technical Advisory Board, 1998**

Named in state law:<sup>1</sup>

Minnesota Department of Agriculture  
 Minnesota Department of Health  
 Minnesota Department of Natural Resources  
 Minnesota Department of Transportation  
 University of Minnesota - Entomology

Others represented:

U.S. Fish and Wildlife Service  
 Minnesota Pollution Control Agency  
 University of Minnesota - Fisheries and Wildlife  
 Hennepin Parks  
 Hennepin County Community Health  
 Environmental group representative  
 Industry representative  
 Independent statistician  
 Entomologist

<sup>1</sup>*Minn. Stat.* §473.716, subd. 2.

SOURCE: Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*, 3-4.

represented on TAB since the early 1990s, along with recent changes. We found that:

- **The process used to determine membership on and appointment to the Technical Advisory Board has not been clear to some agencies.**

In 1997, several TAB members retired from the organizations that they represented. TAB discussed the possibility of having these people remain on the board and recruiting additional members from the organizations that were no longer actively represented. At one point a list of TAB members included retired individuals and new agency representatives, increasing the size of the board. Representatives from the Department of Natural Resources indicated that they were unsure if the agency should appoint a replacement for its recently retired staff member or if it should wait until the District asked for a new appointment. At its December 1997 meeting, TAB recommended that the District review the statutory mandate regarding composition of the advisory board and contact those agencies not represented by active members.<sup>14</sup> As far as we can tell, District staff followed through on this recommendation.

<sup>14</sup> Minutes from Technical Advisory Board Meeting, December 4, 1997: 3.

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**The membership, role, and responsibilities of the advisory board have not been formalized.**

The Technical Advisory Board's role is to review the technical merits of the District's programs as described in the District's annual operations report and in staff presentations and to provide advice about the plans, operations, and goals of the District. TAB chair reports the board's recommendations to the Commission. Since 1994, the TAB has met two times a year, in the spring and fall, its chair has alternated between environmental and regulatory agencies in a predetermined order, and a vice chair position has been added, with that person becoming the next year's TAB chair.<sup>15</sup> We found that:

- **Some Metropolitan Mosquito Control Commission and Technical Advisory Board members appeared to be confused and unclear about the role of the Technical Advisory Board.**

The membership, role, and responsibilities of the TAB have never been formalized. Aside from TAB minutes for past years, there is no document describing the origins, roles, and responsibilities of the advisory board. Recently appointed commissioners have not always been aware of TAB's role. In addition, some TAB members appeared to be unclear about what role the board itself is supposed to fulfill. We recommend that:

- **The Metropolitan Mosquito Control Commission and director should evaluate the composition of the Technical Advisory Board and formalize in a written policy statement the structure, roles and responsibilities, and appointment process of the TAB and communicate these results to agencies represented on the board.**

In addition to clarifying the roles and responsibilities of the TAB, the Commission should evaluate the composition of the TAB and consider what technical skills and areas of expertise are needed on the TAB to review the District's operations and provide sound advice to the Commission. For instance, statistical, toxicology, or other skills may be helpful in TAB's reviews. If these skills are not represented among the board's current members, then the director may want to solicit additional members for the board. The current TAB includes two representatives from Hennepin County and none from other local units of government.<sup>16</sup> The Commission should consider what role, if any, additional local government representatives could fulfill on the Technical Advisory Board.

In recent years the Technical Advisory Board has urged restraint on the part of the District in its use of adult mosquito insecticides to kill nuisance mosquitoes and encouraged the District to focus primarily on treatment of larval breeding sites. The board has also affirmed the appropriateness of the District's tick-borne disease activities, supported continued research on the long-term effects of larval insecticides, and encouraged the District to continue testing new insecticide products.

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<sup>15</sup> Minutes from Technical Advisory Board Meeting, February 25, 1994.

<sup>16</sup> A representative from Hennepin County Planning and Development recently retired but has stayed on the Technical Advisory Board as an "independent statistician." His position was filled with a representative from Hennepin County Public Health, who is a former MMCD employee.

## Other States

To determine how mosquito control services are organized and provided in other states, we interviewed representatives from 28 states.<sup>17</sup> We found that:

- **There is no ideal structure for providing mosquito control services among the states we examined.**

We used categories to classify the level of state involvement in providing mosquito control services (see Figure 5.3). In most states, local units of government (cities and/or counties) provide mosquito control services with varying degrees of state financial, technical, or oversight involvement.

**In most states, local units of government provide mosquito control services.**

**Figure 5.3: Summary of State Role in Providing Mosquito Control Services**

State-Operated Program	Active State Role	Limited State Role	Minimal State Role
Delaware	Florida	California	Iowa
Connecticut	Massachusetts	Colorado	Michigan
Kentucky	New Jersey	Illinois	Nebraska
Maryland	New York	Louisiana	North Dakota
	North Carolina	New Mexico	Ohio
	Rhode Island	<b>MINNESOTA</b>	South Carolina
		Texas	South Dakota
		Vermont	West Virginia
		Virginia	Wisconsin
		Washington	

SOURCE: Program Evaluation Division Telephone Interviews, Summer 1998.

In the group of states we classified as “minimal state role,” local units of government (cities and counties) are responsible for providing mosquito control services, if any are provided at all. The state’s role is limited to state health departments that monitor or investigate insect-borne diseases and may also provide laboratory facilities, testing, training, and technical assistance to local mosquito control programs. This category includes neighboring states—Iowa, North and South Dakota, and Wisconsin.

The “limited state role” category includes Minnesota and other states where state law provides for the creation of local mosquito control districts or provides funding mechanisms (such as the ability to levy property taxes) for locally-operated mosquito control districts. Local governments in these states have not always opted to create local mosquito control districts even though state

<sup>17</sup> These states were selected based on recommendations received during our interviews with MMCD staff and others, reviews of public service and mosquito control association directories, and a search of the Internet.



law gives them this authority. Some states provide technical assistance with program organization or staff training (Colorado, New Mexico), while others may provide some grant money to local programs (Vermont). Essentially, mosquito control services are provided by local units of government.

We classified six states as having an “active state role” even though mosquito control services were still locally provided. These states provide funding to locally-operated mosquito control programs. Some of these states (Florida, Massachusetts, North Carolina, and Rhode Island) have state offices that administer funding or coordinate grant programs and provide technical assistance for local mosquito control programs. Generally, state oversight is limited and involves reviewing annual mosquito control operation reports that are required as a condition to receive state funds and ensuring compliance with pesticide regulations.

**Only four states have state-operated mosquito control programs.**

Finally, we found four states with state-operated mosquito control programs—Delaware, Connecticut, Kentucky, and Maryland. In each of these states, a state agency actually provides mosquito control services either alone or in cooperation with local units of government. Figure 5.4 summarizes some characteristics of these programs. We did not find uniformity among the four states that provide mosquito control services at the state level.

**Figure 5.4: State-Operated Mosquito Control Programs, 1998**

State	Department	Program Priority	Budget	Staff
Connecticut	Environmental Protection	Disease control	\$300,000 <sup>1</sup>	Permanent: 3 Seasonal: 3
Delaware	Natural Resources and Environmental Control	Disease and nuisance control	\$1.4 million	Permanent: 18 Seasonal: 0
Kentucky	Agriculture	Mostly nuisance and some disease control	\$600,000	Permanent: 22 Seasonal: 0
Maryland	Agriculture	Disease control	\$1.9 million <sup>2</sup>	Permanent: 21 Seasonal: 60-70 <sup>3</sup>

<sup>1</sup>In addition, Connecticut Agricultural Experimental Service has a budget of about \$144,000 to do testing for Eastern Equine encephalitis.

<sup>2</sup>Approximately \$600,000 is used to finance 50/50 matching grants to local programs. The remainder of Maryland’s mosquito control program budget supports state program staff (biologists and entomologists) and administrative and other costs.

<sup>3</sup>Represents seasonal staff working in state program; data do not include local programs.

SOURCE: Program Evaluation Division Telephone Interviews, Summer 1998.

## PUBLIC NOTIFICATION OF TREATMENT

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**Public notification of adult insecticide applications is a concern of some legislators, state agencies, and environmentalists.**

Some legislators, representatives of state agencies, and environmentalists have raised concerns about how MMCD notifies the public about its operations. Most complaints have centered on notifying the public when insecticides are applied to kill adult mosquitoes. Staff from the Minnesota Department of Health advise people with “multiple chemical sensitivity” to avoid the risk of exposure to insecticides, as well as perfumes, carpet, chemicals, and other substances. Department staff emphasize that people need information to avoid exposure and that MMCD has a responsibility to inform people about when and where insecticides are being applied so that people can choose to avoid exposure. The Department feels strongly that MMCD should post adult applications.<sup>18</sup> In the past, the District’s Technical Advisory Board has also recommended that MMCD increase its efforts to notify people of adult mosquito treatments.<sup>19</sup>

The District has attempted to respond to these concerns by providing information to the public in a variety of ways. The District’s adult mosquito treatment policy contains specific instructions related to providing notification. The District uses a telephone information line and a web site to inform people about scheduled adult mosquito treatments. Scheduled adult mosquito treatments are identified by county and specific location and the information is available by 4:30 p.m. for that evening and the following day. For people who want an individual telephone notification of cold fog resmethrin applications, staff in the regional offices will attempt to contact them or leave a message before treatment.<sup>20</sup> The policy also states that areas treated with permethrin will be posted during treatment.

Currently, the only policy statement related to public notification is contained in the District’s adult mosquito control policy. However, citizens have requested and the District has provided individual notification of larval treatments, especially applications made by helicopter. We recommend that:

- **The Metropolitan Mosquito Control Commission should develop a public notification policy that addresses both larval and adult mosquito control treatment.**

In 1994, the District conducted a pilot project to evaluate methods of informing citizens of adult mosquito treatments. The trial was done in three geographic areas (Excelsior, Ham Lake, and Mounds View) using three notification methods (posted street signs, dropped literature at residents’ doors, and put notices on community cable television bulletin boards). Study results indicated that the majority of residents wanted to be notified about treatments. A slightly higher

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<sup>18</sup> Ms. Rita Messing, Minnesota Department of Health, Interview, St. Paul, Minnesota, August 10, 1998. According to the Department of Health, multiple chemical sensitivity is not a medically recognized syndrome. The department does not have any data on the number of people suffering from multiple chemical sensitivity.

<sup>19</sup> Minutes from Technical Advisory Board Meeting, March 17, 1993.

<sup>20</sup> Metropolitan Mosquito Control District, Adult Mosquito Treatment Policy, *Administrative Manual*, June 1, 1998: 2; Metropolitan Mosquito Control District, *Field Operations Manual*, Chapter IX: Adult Mosquito Control, May 1998: 9.

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**The District maintains a telephone information line and a web site to inform people about scheduled adult mosquito treatments.**

percentage of residents in the area receiving literature were aware of the notification compared with those living on streets with posted signs. None of the residents in the community receiving cable television announcements were aware of the notification.<sup>21</sup>

MMCD posted daily adult mosquito treatment information on its web site in 1998. According to MMCD staff, individuals accessed the site 500 times during the summer months. Use of the site varied from a few “hits” on some days to several on others (such as around the July 4th weekend).<sup>22</sup>

Almost 850 calls were made to the adult mosquito information line in 1997, nearly twice as many as in 1996. Most of these calls (41 percent) were from Hennepin County, followed by Anoka (18 percent) and Ramsey (14 percent) counties.<sup>23</sup> We conducted a mail survey of people who called the District during the summer of 1997 to request services or information or to refuse service. We found that:

- **Of the 248 people surveyed, only 9 percent responded that they were aware of the District’s telephone information line and web site informing people about adult mosquito applications.**

Most of the survey respondents who indicated they were aware of these resources had also used either the telephone line or the web site during the summer of 1998. These numbers indicate that few citizens in the Twin Cities area are aware of the District’s efforts to inform people of adult mosquito treatments.

We also examined how other Minnesota cities provide public notification using information reported on the Municipal Pest Control application forms filed by Minnesota cities with the Department of Agriculture. Officials from Minnesota cities providing mosquito control services in 1997 and 1998 used a variety of methods to notify citizens of treatments. Of the over 40 cities, about one-half (23 to 25) used local newspaper and/or radio announcements to provide notice of treatment, one-third (15) used local cable television, and one-fourth (11 to 12) posted notices and/or made telephone calls to provide citizens with notice of treatments.

Of the four states with state-operated mosquito control programs, three provided public notification using various techniques. Delaware and Maryland used newspaper advertisements to notify citizens of adult mosquito treatments and made telephone calls to people who requested to be notified. Connecticut published an annual notice in newspapers related to both larval and adult mosquito control treatments and made telephone calls to people who requested notice. Kentucky did not provide any notification. It is difficult to generalize about the methods used in other states we contacted since mosquito control was provided by local units of government. Generally, the techniques used in other states have

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<sup>21</sup> Metropolitan Mosquito Control District, *1994 Operational Review and Plans for 1995*: 26, 29.

<sup>22</sup> Preliminary report to the Technical Advisory Board on MMCD 1998 operations, December 4, 1998.

<sup>23</sup> Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*: 13.

included annual and/or weekly newspaper advertisements, announcements on local television, radio, and cable channels, telephone calls to individuals, telephone hotlines, and web sites.

Currently, Minnesota statutes do not contain language related to public notification for mosquito control treatments.<sup>24</sup> During the 1997 legislative session, a bill was introduced which would have required, among other things, that MMCD:

- 1) post notices on public land of planned larval and adult mosquito control applications at least 48 hours in advance and at least every 100 feet;
- 2) notify residents of private property in person or by placing information on the residents' doors at least 48 hours before adult or larval applications within 300 feet of agricultural land or within 1,000 feet of a residence; and
- 3) notify designated public officials at least seven days before adult or larval control applications within a statutory or home rule charter city or town.<sup>25</sup>

Information contained in the notice would have included the scheduled day and time of application, the name of the products to be used and their active and inert ingredients, and all precautionary statements from the product label related to human, domestic animal, and environmental hazards. The notices posted on public land would have included a telephone number to call for additional information, and the private property notices would have included information on the right to refuse application and the procedure for doing so.

The bill did not pass, but the District and the authors of the proposed legislation later reached a "negotiated agreement," which lacks the force of law. This agreement differed from the bill that was introduced in that it applied only to adult mosquito control treatment, required MMCD to publish a newspaper advertisement, required that notices be posted at the main entrances to public land being treated, and changed the notification of individual private property residents to pilot projects. The agreement required MMCD to:

- 1) publish an advertisement each spring in all local newspapers of general circulation notifying the public of possible adult mosquito insecticide applications;
- 2) before adult mosquito control treatments on public land, post notices at the main entrances of the land and leave the signs in place for as long as the insecticide remains active according to the product label;

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**The District  
expanded its  
public  
notification  
efforts in 1998.**

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<sup>24</sup> *Minn. Stat.* §18B.09, which allows statutory and home rule charter cities to enact an ordinance requiring commercial or noncommercial lawn care applicators to post warning signs on the property where lawn care pesticides have been applied, does not apply to mosquito control operations. Of the states we contacted, only four have public notification provisions in state law—Connecticut, Massachusetts, Michigan, and New York.

<sup>25</sup> *Minn. House* (1997), H.F. no. 2320, as introduced.

- 3) conduct four pilot projects providing individual notification to private property residents in order to compare the effectiveness of individual notification to that of spring advertisements;
- 4) notify chief administrative officials of a city or town when adult mosquito applications will take place within their city or town; and
- 5) report to the Legislature on July 1, 2000 on the results of the four pilot projects and the cost and effectiveness of individual notification and spring advertisements.<sup>26</sup>

The Commission published an advertisement in local newspapers of general circulation in May 1998. The District has also posted notification of adult mosquito applications made in public lands, primarily parks and recreation areas, during the summer of 1998. Generally, MMCD left the signs up for 5 to 7 days, the amount of time that District research has determined permethrin to be effective, rather than the 14 days cited on the permethrin product label. District employees notified public officials once in the early summer about possible treatments for adult mosquitoes in their jurisdictions. Finally, in September the District conducted several focus groups to gather information on different ways of providing public notification and included questions about public notification in its 1998 telephone survey of citizens. There may be some disagreement among parties to the negotiated agreement about whether these activities qualify as the pilot projects.

Since 1994, MMCD has conducted a telephone survey of residents in the Twin Cities metropolitan area every two years, asking people about their impressions of MMCD and their opinions about mosquito control. In its 1998 survey, the District asked if the people surveyed had seen an advertisement that the District ran in local papers in May. Only 11 percent of people responding to the survey said that they had seen the notice.<sup>27</sup>

We recommend that:

- **MMCD should continue the level of public notification provided during the summer of 1998.**

We think the District should continue its current public notification efforts, including those that were part of the negotiated agreement in 1998. The District should publish an annual advertisement in newspapers in the spring of each year, containing information on the nature of mosquito control treatments and accurate, objective information on the insecticides used. Our review of other states showed that this is a commonly used method of public notification. We also think the District should continue posting notices of adult mosquito treatments at the entrances of public parks and recreation areas. This will provide people with information allowing them to avoid exposure to insecticides if they so choose. If

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<sup>26</sup> *Minn. House* (1997), H.F. no. 2320, delete all amendment, Revisor no. H2320A3, 2/10/98.

<sup>27</sup> The District did not ask about the public's awareness of its telephone information line or web site that provide information about adult mosquito treatments.

the Legislature finds in the future that the District has not provided these notifications, then it should consider adding public notification requirements to state law.

## RELATIONSHIP WITH THE PUBLIC

As part of its biennial telephone survey of residents in the Twin Cities area, the District asks people about their awareness of MMCD and its activities. The District says that this survey is “a very useful tool in monitoring citizen needs and expectations, and evaluating the effectiveness of [its] public information efforts.”<sup>28</sup> In its 1998 survey, MMCD found that:<sup>29</sup>

- **Sixty-one percent of people surveyed by the District in 1998 were aware of the Metropolitan Mosquito Control District.**

The proportion of survey respondents who were aware of the District in 1998 was virtually unchanged from prior years. In its 1994 and 1996 surveys, 64 percent and 62 percent of the survey respondents said they were aware of the District.

In 1997, nearly 2,600 people called the headquarters office of the District. Citizens called to request: adult mosquito, breeding site, and biting gnat treatments; treatments at public events; waste tire pick-ups; that property not be treated; and information. Requests for adult mosquito treatments represented 55 percent of all requests, followed by waste tire pick-ups (14 percent), and mosquito breeding site treatments (13 percent). We were unable to determine the number of callers asking that their property not be treated because “no treatment” requests were labeled “immediate response” and grouped with other calls requesting immediate service. During 1998, there was a significant increase (48 percent) in telephone calls from the public, most (62 percent) of which were requests for additional mosquito treatments.

We conducted a mail survey of a random sample of the citizens who called MMCD in 1997.<sup>30</sup> Of the people surveyed, nearly 80 percent said they had called the District to request treatment of larval or adult mosquitoes. When asked to rate their satisfaction, nearly 80 percent said they were “satisfied” or “very satisfied” with the District’s response to their request. Only 8 percent of the people responding said they were “dissatisfied” or “very dissatisfied” with the District’s response. Based on our survey, we conclude that:

- **There is a high level of satisfaction among people requesting service from the Metropolitan Mosquito Control District.**

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**In 1997, requests for adult mosquito treatments represented 55 percent of nearly 2,600 telephone calls to the District.**

<sup>28</sup> Metropolitan Mosquito Control District, *1997 Operational Review and Plans for 1998*: 14.

<sup>29</sup> The question read: “Are you aware of a local government agency called the Metropolitan Mosquito Control District, referred to as MMCD?”

<sup>30</sup> Approximately 2,600 people called the District in 1997 for various reasons. In August 1998, we mailed a questionnaire to a random sample of 368 citizens who called the District in 1997. Of these, 248 responded for a response rate of 67 percent.



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**The District should be careful to present the most accurate information possible to the public.**

Despite high satisfaction ratings from some segments of the population, the Metropolitan Mosquito Control District has found itself in an adversarial position in recent years as environmentalists question the District's operations. During the summer of 1998 there was an intense public relations debate between the District and environmental groups, and we became aware of a certain level of mistrust among the parties involved. In this type of atmosphere, we believe it is crucial for the District to be sensitive to the public's need for information and to exercise the utmost care in presenting the most accurate information possible to the public. Unfortunately, the District might have contributed to feelings of mistrust by making claims that are hard to support, such as the assertion that requests for "no treatment" impair its ability to protect public health and prevent LaCrosse encephalitis. While we have noted that MMCD provides valuable insect-borne disease prevention services, we have also observed that most of the District's adult mosquito treatments are directed at nuisance mosquitoes. Research has shown that the most effective way to prevent LaCrosse encephalitis is to eliminate tree hole mosquito breeding sites. State law gives the District authority to take necessary mosquito control measures in situations of disease outbreak, regardless of refused treatment requests.

We also heard complaints from people who refused the District access to their property in 1998. Early in the summer, District staff sent letters to these people, acknowledging that the District had received and would honor their request. The letter also tried to persuade property owners to reconsider their request and implied that their refused treatment request might hinder the District's disease prevention activities. The District stopped sending the letter after it received negative reactions about the letter's content. We think that MMCD should make more of an effort to present balanced, accurate information to the public.

## SUMMARY

The Metropolitan Mosquito Control District is governed by a 17-member commission composed of county board members from participating counties. The Commission is considered a "special taxing district." As far as we can determine, the Commission generally has complied with most state laws designed to provide public accountability. Our study revealed that the Commission did not file a financial report with the Legislature in 1996 and it has not always classified information on citizens as required under the state Data Practices Act.

We do not recommend major changes in the governance structure of the District, but the Legislature should consider reducing the size and changing the composition of the Commission. We suggest that representatives from a couple of state agencies and/or public members appointed by the Governor could be added to the Commission. We also recommend that the District evaluate the composition of its Technical Advisory Board and formalize the structure, roles, responsibilities, and appointment process for the board.

The District has a responsibility to notify citizens of the Twin Cities area about its activities. The District currently does this using a telephone information line, web site, telephone calls to people requesting notification, posting notices of adult mosquito applications on public land, and other techniques. We recommend that

the Commission develop a public notification policy that addresses both larval and adult mosquito control activities. We also recommend that the District continue the level of public notification it provided during the summer of 1998.

This chapter reported that 61 percent of people surveyed by the District in 1998 indicated that they were aware of the District. Nearly 80 percent of the people who called the District in 1997 and were surveyed as part of our study indicated that they were “satisfied” or “very satisfied” with the District’s response to their phone call. However, there is also a level of mistrust between the District and some environmental groups that the District might be able to reduce by presenting more accurate and balanced information about its operations.



## **METROPOLITAN MOSQUITO CONTROL DISTRICT**

**METRO COUNTIES GOVERNMENT CENTER**

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JOSEPH F. SANZONE, BCE

Director

W.J. CAESAR

Business Admin.

January 5, 1999

James R. Nobles, Legislative Auditor  
Office of the Legislative Auditor  
Centennial Building  
658 Cedar Street  
Saint Paul, MN 55155

Dear Mr. Nobles:

We thank you and your staff for the professional manner with which you conducted the evaluation of the Metropolitan Mosquito Control District (MMCD). The Metropolitan Mosquito Control Commission (MMCC) appreciates the auditor's efforts in reviewing our program, and values the observations and recommendations offered. As Representative Ann Rest said at the Legislative Audit Commission meeting last spring, one of the primary goals of a program audit should be to identify ways to use tax dollars more efficiently. We look forward to incorporating your evaluation into our program keeping this goal in mind.

Controlling mosquitoes and biting gnats in the most environmentally sensitive manner is a serious responsibility, and your finding that the District is using appropriate control materials and methods is encouraging. MMCD is pleased with your conclusion that the control materials used by the District to kill mosquito and black fly larvae pose little risk to people and most nontarget species. In addition, you summarize that the Environmental Protection Agency, the World Health Organization, and the Minnesota Department of Health have found that resmethrin and permethrin, the control materials used to kill adult mosquitoes, should not be harmful to humans or the environment if applied according to label instructions.

Concerning governance of the District, our board believes very strongly that direct governance should remain with elected county commissioners who are accountable to the public for decisions and have experience in setting policy and administering programs. We disagree that having non-elected members representing special interests on our board would enhance our public responsiveness. In 1985 the District created a Technical Advisory Board (TAB) to facilitate cooperation with state agencies and the U. of MN, review the District's plans and operations, and present its ideas and recommendations to the Commission. Originally, TAB membership was comprised of professionals representing state agencies and the University of Minnesota. MMCD has expanded membership to include representatives of industry and environmental interests to gain even broader perspectives. The Commission believes that in its current form TAB provides

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an appropriate and responsive vehicle for other special interest input and independent perspectives. We do agree with your suggestion to formalize in writing the structure, roles and responsibilities, and appointment process for the TAB - and we will immediately begin that process.

Since its creation in 1958 MMCD has generally respected requests by private citizens and public property managers, including the Department of Natural Resources, to refuse treatment for larval and/or adult mosquito control operations unless public health considerations - such as disease or severe annoyance - dictated differently. The District's program is environmentally sensitive and establishes very liberal buffer zones for adult control materials to avoid affecting these properties. For over 40 years we have treated access onto public and private property as a privilege although the Legislature created that access as a statutory right.

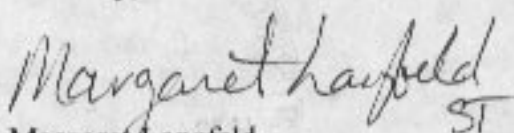
The intent of the state law related to MMCD's access to public property is clear. MMCD's activities related to physical modification of waterways are subject to state and county authority, but the Legislature wisely vested all other control decisions in the hands of MMCD's scientists and other professionals; that decision was clarified in 1982 with a specific directive to the DNR to allow MMCD access to state property for necessary and proper program purposes. Since research has shown, and OLA's evaluation has supported, the relative safety of our program, and that MMCD has used its statutory right responsibly and judiciously we suggest the existing statutes remain as written.

In the past MMCD has considered information on citizens who request or refuse service as non-public data. This information was not made public because experience showed that sometimes it caused conflicts. In October 1998 the District received an advisory opinion from the Minnesota Department of Administration regarding this issue. Within the opinion received, the District's counsel recommends that most of this information be classified as public in the future.

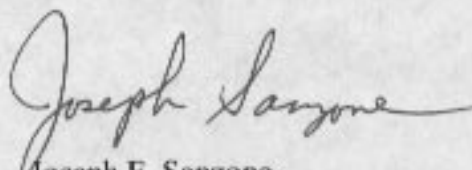
Finally, as you recommend, the District will continue the level of public notification provided in 1998, and will take the utmost care in presenting the most accurate information possible to the public. In 1998 the District contracted with the Wilder Foundation to conduct focus groups dealing with notification. These focus groups provided us with valuable information on what citizens want and expect regarding notification and other issues. The District will use this information to enhance our notification efforts, and improve communication with the public.

Again, we want to express our appreciation to the Office of the Legislative Auditor, and look forward to using this program audit to help in our ongoing efforts to improve service and use tax dollars more efficiently.

Sincerely,



Margaret Langfeld  
Chair, MMCC



Joseph F. Sanzone  
Director, MMCD

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