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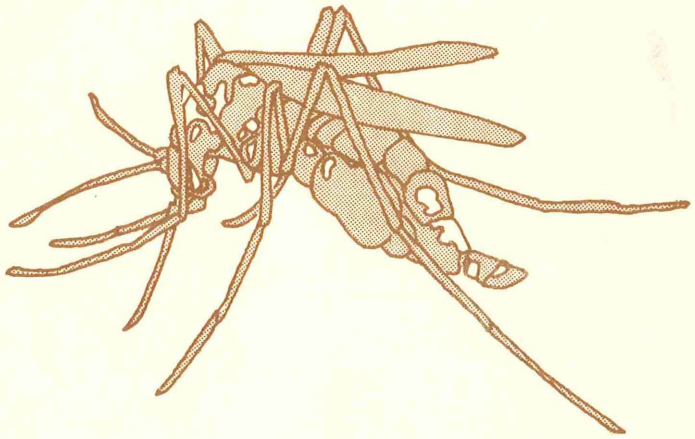

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exhibit a.

GENERAL ENVIRONMENTAL DESCRIPTION OF THE TWIN CITIES METROPOLITAN AREA

The seven county region surrounding the cities of Minneapolis and St. Paul and their suburbs is commonly referred to as the "Twin Cities Metropolitan Area." Although Carver County is not presently within the boundaries of the Metropolitan Mosquito Control District its ecological features have not been excluded from this general environmental discussion.

LOCATION

The Twin Cities Metropolitan Area is situated in east-central Minnesota and centered at approximately 44°50' north latitude and 93°15' west longitude. The area is located some 1800 miles east of the Pacific Coast, 1100 miles west of the Atlantic Coast and 1200 miles north of the Gulf Coast. The average altitude of the area is 830 feet above sea level, varying from 680 feet along the Mississippi River to over 1200 feet at the crest of higher hills.

CLIMATE

The climate of the Twin Cities Area is most often referred to as "humid-continental" characterized by temperature extremes from winter to summer. January and July are the months of coldest and warmest temperatures. The extremes of temperature on record for these months are 108°F (1936) and -41°F (1888). Normal temperatures range from 11.2°F to 70.0°F. The mean annual temperature is 45.1°F and annual rainfall averages 24.8 inches. Snowfall is usually heaviest in March when extremes have been recorded in excess of 35 inches. Seasonal average temperatures and precipitation are shown in Table ES-1.

Area climate would be very dry except for topographical features of the continent, which induce thunderstorms accounting for 50% of the annual precipitation. These storms which rage from May through September, occur in association with a stream of air aloft, flowing from the Gulf of Mexico. The Twin Cities are normally just barely included in the western part of this air stream. When the air flows farther to the east, drought results.

Table ES-1

Seasonal Average Temperatures and Precipitation for the Twin Cities Metropolitan Area

Season	Usual Range of Average Mean Temperature (0°)	Usual Range of Average Precipitation (inches)
Winter	15 - 18	2.0 - 2.5
Spring	43 - 45	7.0 - 7.5
Summer	69 - 71	11.0 - 12.0
Autumn	46 - 48	5.5 - 6.0

Source: Huff, 1976a.

This is usually the case between July 10 and August 20, a normal period of midsummer dry spells. The heaviest precipitation occurs in mid June with a secondary peak about September 12. In recent years this secondary peak has been weak, resulting in dry Augusts and Septembers. June rains have been heavier, however, even in the 1976 season of severe drought.

Wind in the Twin Cities area is predominantly northwesterly or southeasterly in the winter and summer respectively. Southwesterly winds are significant and frequent nighttime occurrences, however. At night they are generally light (under 6 miles per hour). They are strong during the day, however, in July, August and October at which time they are associated with high levels of air pollution.

Fog conditions vary greatly throughout the area. On high ground fog is a common winter phenomenon and may also occur between March and April in association with melting snow. In low spots, fog is common in the fall and may occur year-round in association with shallow nighttime inversions.

In drier air, cold air pools may exist without fog, even with overcast skies. These pools represent near-the-surface inversions and occur three out of four days in the summer. They are usually at least 20 feet deep. Deeper inversions form between 100 and 1000 feet above the ground over the entire Twin Cities area nearly half the nights during the summer.

GEOLOGY

The bedrock beneath the Twin Cities area is sedimentary and was laid down by the Cambrian and Ordovician Seas which once covered the area. Beneath these formations lie pre-Cambrian formations of igneous and metamorphic rock which were deeply eroded by natural phenomena prior to the encroachment of the Cambrian seas.

Cambrian deposits are sandstones and dolomites reaching a maximum thickness of 1000 feet. Ordovician deposits consist of limestone, dolomite, shale and sandstone. The seas receded to the south during subsequent Carboniferous, Triassic and Jurassic periods. Fluvialate and estuarine beds from the Cretaceous Period are known in the area. No Tertiary deposits are known, although the Mississippi River drainage was established during the period. Quarternary deposits are widespread with glacial drift of several hundred feet in thickness covering much of the surface.

The area was glaciated five separate times and evidence of all but the earliest epoch are present in the Metropolitan region. The glaciers left extensive deposits in the form of sheets and hills (moraines) which have been highly eroded since the last glacial period.

PHYSIOGRAPHY

Geomorphic regions dominant in the Twin Cities physiography have been identified by Wright (1972) as the Owatonna moraine, the Rochester till plain, the Eastern St. Croix moraine, the Anoka sand plain and the outwash valley regions associated with the major river systems.

These predominant regions have been categorized into a series of second level land forms by Harms

et al., (1975) and subsequently interpreted for suitable land uses by Hanson et al., (1976).

Hanson's interpretation derives from an appreciation of soil classifications and is thus significant in an assessment of the direct infiltration characteristics of the area.

A township map summarizing these physiographic landforms and soil associations is shown in Figure ES-I. A generalized map of the geology of the unconsolidated surficial deposits according to their lithology is presented in Figure ES-II as generalized from Parham et al., (1974).

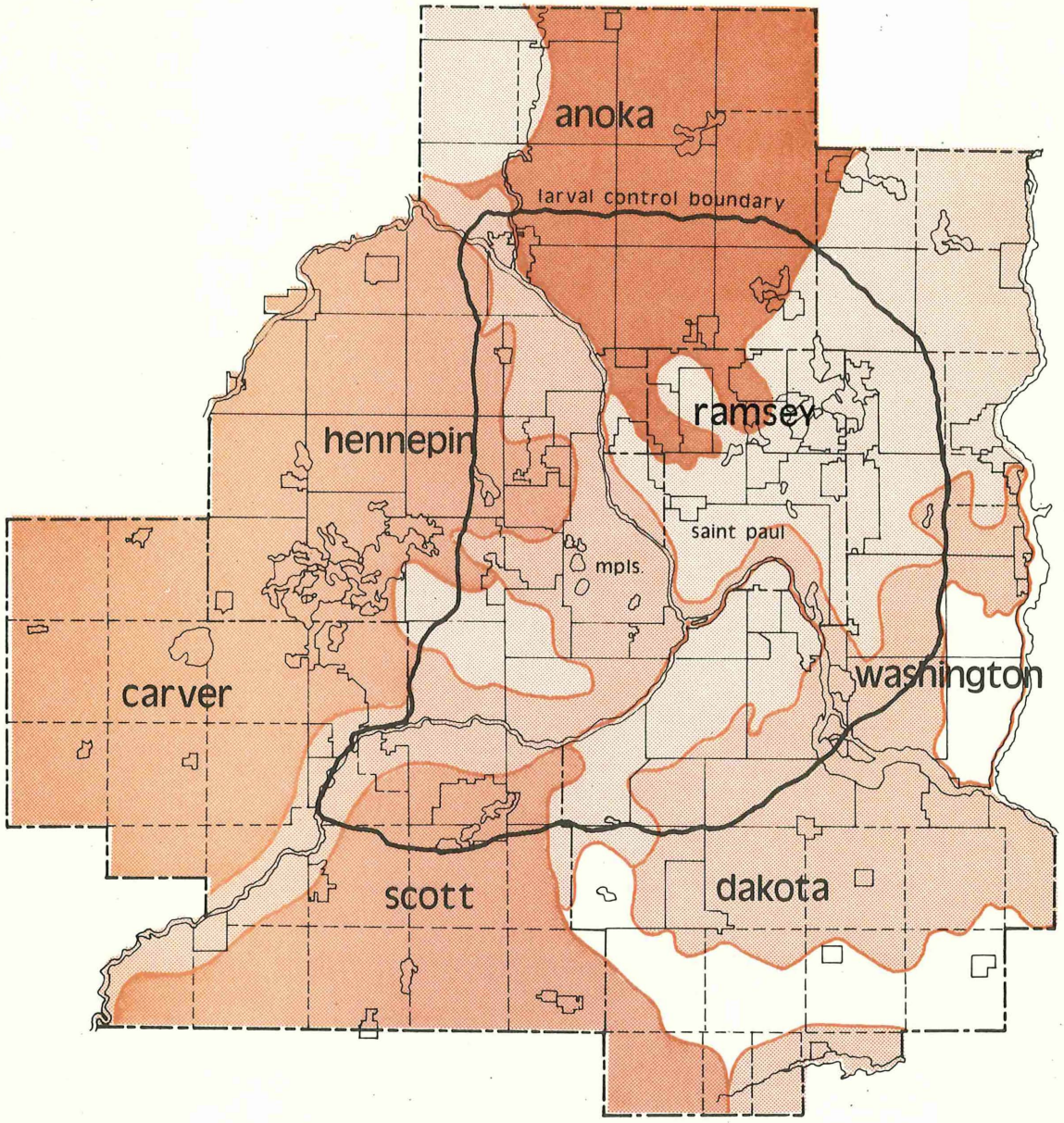
Moraine areas consist basically of till and are visible as irregular rolling, hummocky topography. They often have ice disintegration or collapse features of loamy texture. Surface drainage systems are not well developed, leaving many unconnected depressions which are prime candidates for runoff collection and retention. Impermeability of the depression may be a result of several factors: low permeability of the original material in place; inwash of very fine particles with the runoff from the surrounding area; or the development of peat on other organic deposits. These factors intervene in the Prior Lake moraine, for example.

The irregular topography of knolls and depressions lends itself to the collection of standing meltwater when the ground is frozen, even when the soil is permeable.

The surficial geology determines, through its lithology, the ease with which surficial drainage networks can be developed and the ease with which water (once infiltrated) is carried away into the groundwater. In the Anoka sand plain, for example, surface sand is well drained, but subsequent subsurface runoff is impeded by less permeable layers of underlying till.

HYDROLOGY

The surface water of the region is held in many lake basins ranging in size from 10 to 14,500 acres. Drainage occurs through a system of three



river outwash
owatonna moraine
rochester till plain
anoka sand plain
twin cities formation

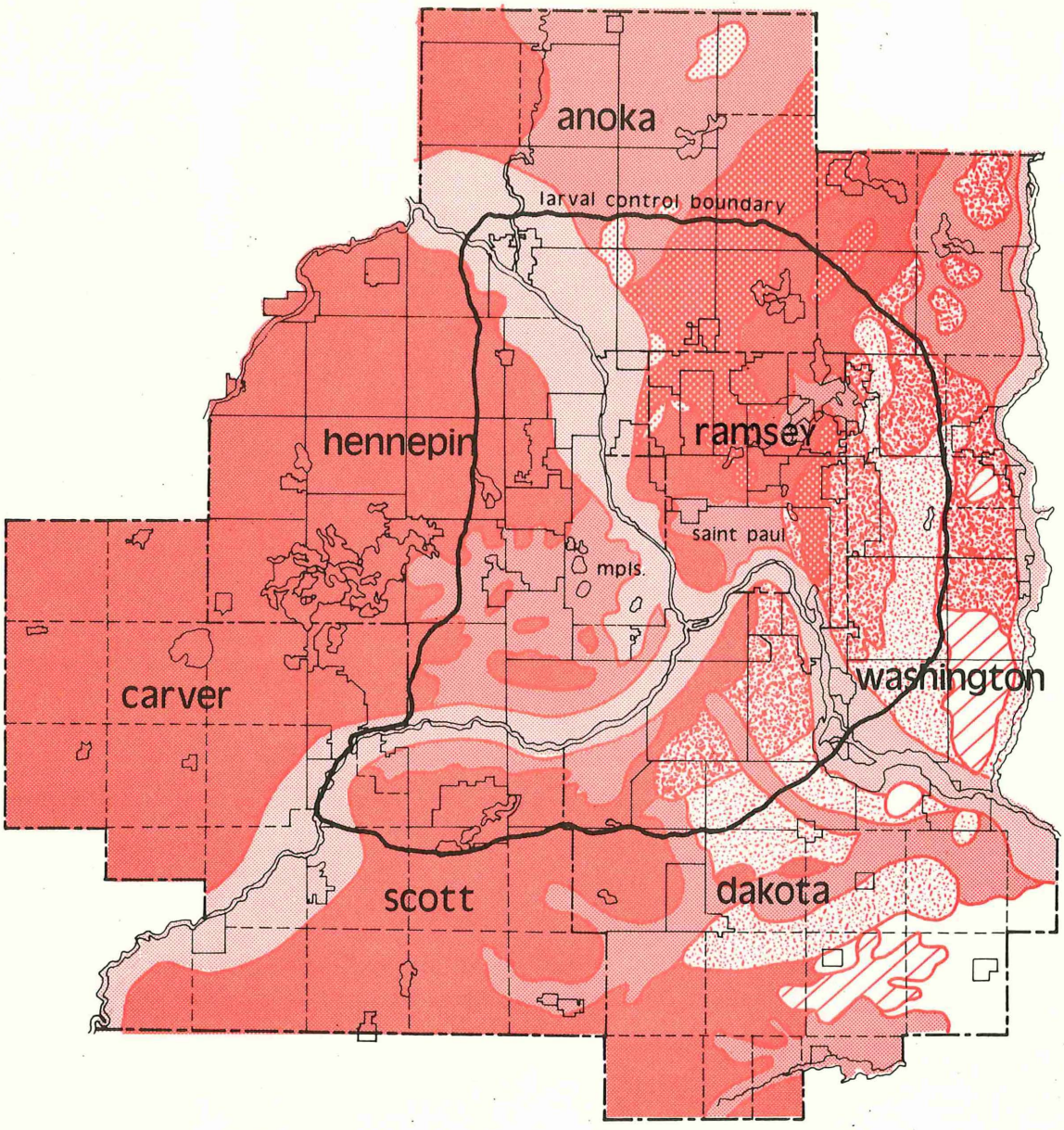
source: Harms et al., 1975.

figure 1.

physiographic landforms and soil associations

miles 0 5 10 15 20 n

john and michele genereux



gray till
outwash from gray till (sand and gravel)
red till
outwash from red till (sand and gravel)
undifferentiated drift
terrace deposits and alluvium (sand and gravel)
lake deposits (sandy)
wind deposits
bedrock at or near surface

source: Parham et al., 1974.

figure II.

generalized surficial geology

miles 0 5 10 15 20

n

john and michele genereux

major rivers, several smaller rivers and numerous streams, brooks and creeks of permanent and seasonal flow. The lakes range to 80 feet in depth and the rivers vary from slow and sluggish to fairly rapid.

Most lake basins in the area are of glacial origin and do not extend below the level of glacial drift. A few are of river ox-bow and ice block origin. Many lakes are sealed off from the glacial till by layers of clay and a few of the deepest lakes are connected to bedrock aquifers.

Local aquifers are recharged through lateral flow (from other aquifers), directly from precipitation at outcrops and, most commonly, by percolation of rainwater and snowmelt through overlying layers.

A generalized overview of lake distribution, as adapted from Daley and Carlson, 1967 and Brown et al., 1975, is presented in Figure ES-III.

The hydrogeologic characteristics of the soil and subsurface materials determine infiltration and percolation rates. Vertical hydraulic conductivities (P') for the most prominent surficial deposits have been estimated and verified by Larson-Higem et al., (1975) and are listed in Table ES-2.

In point, the till material from the Owatonna moraine will be slightly less permeable than the material from the St. Croix moraine. P' of coarse materials such as the sand, gravel, clay and silt mixture are the product of sorting processes on which they depend more strongly than on their glacial source material.

HYDROGEOLOGY AND THE DEVELOPMENT OF MOSQUITO BREEDING SITES

Hydrology and related mosquito density can be addressed from three perspectives: (1) factors contributing to the establishment of mosquito breeding sites; (2) factors conditioning the actual breeding process and (3) other physical conditions which affect the normal influence of hydrology on the establishment of sites and the breeding process.

Table ES-2

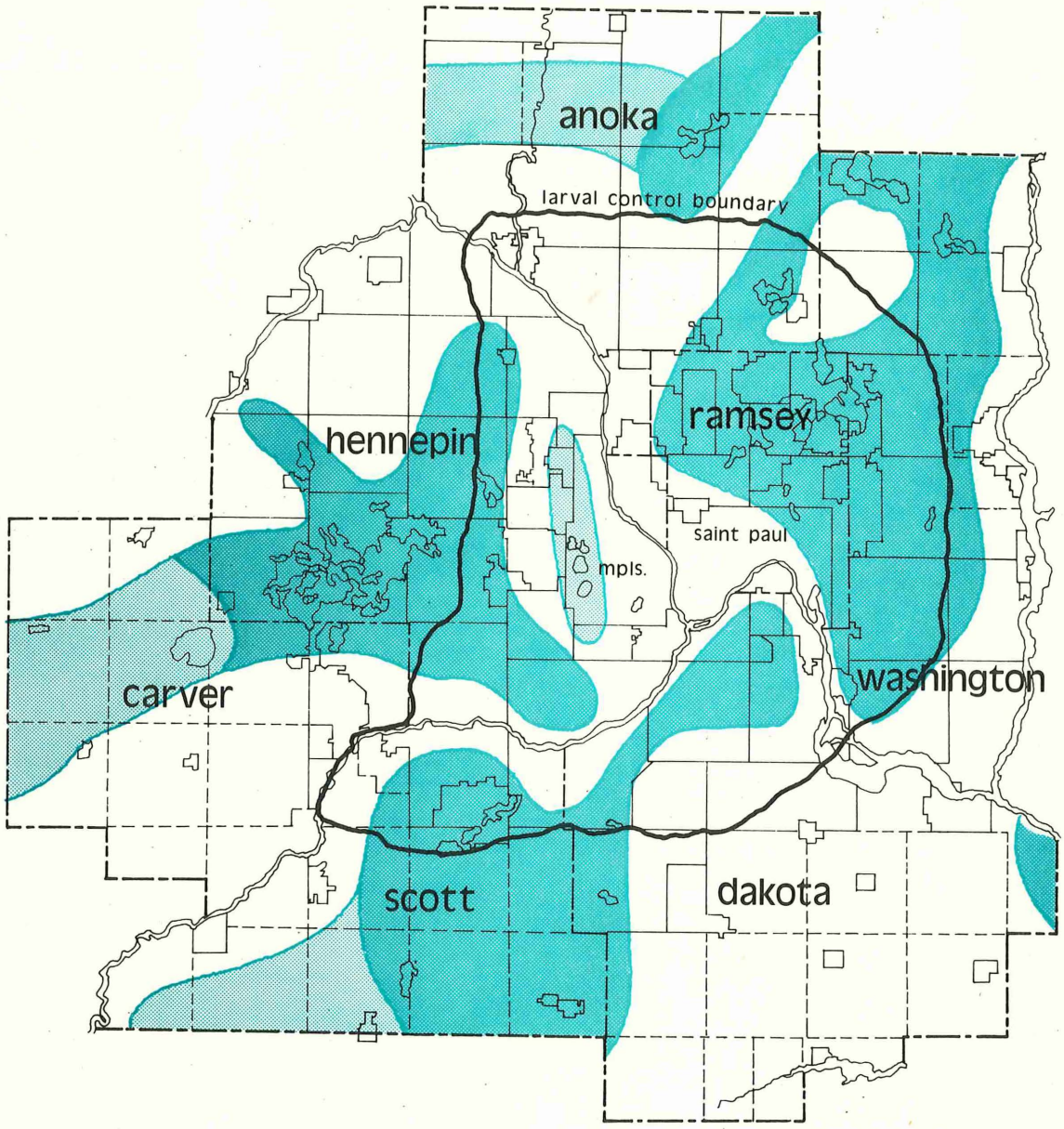
Vertical Hydraulic Conductivity of Major Surficial Deposits in the Twin Cities Area

Feature	P' (m/day)
Outwash - till	
sand and gravel	0.00073
some clay and silt	0.64
Red Drift till - (St. Croix)	0.00061
sand, gravel, silt and clay	0.64
Gray Drift till (Owatonna)	0.00055
sand, gravel, silt and clay	0.64

Source: Pfannkuch, 1976

The most important hydrologic factors contributing to the establishment of mosquito breeding sites which may be subject to control include:

- physiography and topography;
- the degree of development of a surface water drainage system;
- infiltration opportunities provided by regional and local slope;
- the infiltration capacities of soils;
- the transmissivity of unconsolidated material in the aerated zone;



low density
medium density
high density

source: Brown et al., 1975, and Daley and Carlson, 1967.

figure III.

generalized lake distribution

miles 0 5 10 15 20 n

john and michele genereux

- depth of the watertables;

- amplitude of watertable fluctuations;

- the interconnection between groundwater and surface water features.

The actual breeding process in established breeding sites depends on the magnitude and frequency of precipitation, other meteorologic events and the persistence of favorable climatic conditions.

Significant aspects of physiography and surficial geology were noted in the previous subsection. The irregular topography of the area was noted with special attention given to the abundance of depressions and their capacity to retain water. This feature relates directly to mosquito density. See Table ES-3 for calculations of drainage areas in breeding sites in four regional townships. See also Table ES-4 for calculations of actual rainfall collection in a breeding site. Over 60% of the annual Metropolitan mosquito population are developed in pothole depressions. A detailed breakdown of breeding sites in regional townships appears at the end of this section (Table ES-5).

High mosquito density coincides with physical features of the Anoka sand plain to the north of the region and three portions of the Owatonna moraine to the west and southwest: the Waconia-Waseca, Prior Lake and Emmons-Fairbault moraines. Further high density breeding sites are associated with portions of the Minnesota Valley outwash in northern Scott and northeastern Dakota Counties, especially connected with the large marshy areas near Bloomington (identified as deep marshes No. 2, 13, and 83 in Daley and Carlson, 1967).

Areas of moderate breeding site density appear to be associated with parts of the St. Croix moraine, especially the Twin Cities formation in St. Paul and eastern Dakota County. Similar associations exist in the Mississippi Valley outwash in Hennepin, Washington and Dakota Counties as well as in the uplands of the Rochester till plain in southern Washington and Dakota Counties.

Table ES-3

Drainage Area Contributing Runoff to Breeding Sites in Four Counties

Anoka County
Twp. Coon Rapids

Co.	Twp.	Sec.	B.S.	Acres	Acres Watershed
02	10	11	5	.9	3.5
02	10	11	9	.25	1.1
02	10	11	9-D	.6	1.8
02	10	11	25	.3	1.2
02	10	11	16-B	.3	1.2
02	10	14	6	1.3	5.0
02	10	15	2	3	15
02	10	14	10	.5	1.8
02	10	23	4-C	.6	2.6
02	10	25	18	.2	1.0
				7.95	34.20

Dakota County
Twp. Lakeville Sec. 7

Co.	Twp.	Sec.	B.S.	Acres	Acres Watershed
19	11	07	22	.1	.2
19	11	07	133	.1	.3
19	11	07	20	.2	.4
19	11	07	23	.3	.8
19	11	07	130	.2	.3

Table ES-3, Continued
Dakota County
Twp. Lakeville Sec. 7

Co.	Twp.	Sec.	B.S.	Acres	Acres Watershed
19	11	07	2	.7	2.3
19	11	07	18	.1	2.0
19	11	07	19	.2	2.0
19	11	07	24	.4	1.0
19	11	07	111	.2	.8
				2.50	10.10

Hennepin County
Twp. Maple Grove Sec. 17

Co.	Twp.	Sec.	B.S.	Acres	Acres Watershed
27	32	17	6	1.5	2.5
27	32	17	7	.6	2.5
27	32	17	11	1.1	4
27	32	17	16	.8	4
27	32	17	17	1.3	7
27	32	17	18	.5	3
27	32	17	20	.5	5
27	32	17	25	.5	4
27	32	17	27	.5	3
27	32	17	28	.5	3.5
				7.80	38.5

Table ES-3, Continued

Scott County
Twp. 5 is Eagle Creek
Twp. 12 is Spring Lake

Co.	Twp.	Sec.	B.S.	Acres	Acres Watershed
70	5	17	2	1.2	5
70	5	18	1	1.3	10
70	12	13	41	.3	3
70	12	13	35	.8	2.5
70	5	24	11	.6	3.3
70	5	26	34	.3	3.2
70	5	26	19	.5	6.1
70	5	33	11	1.2	5.3
70	5	35	28	.5	3.4
70	12	15	35	.2	1.5
				6.90	43.30

SUMMARY: No. of sites 40
Acreage B.S. 25.15
Watershed 125.30
Average site 0.63 acres
Average drainage area 3.15 acres
Ratio Drainage area: Breeding site area = 126.1:25.15 = 5.01

Source: Pfannkuch, 1976

Table ES-4

Formula for Rainfall Collection in Actual Breeding Sites

Rainfall collection calculations:

Precipitation	1.5 inches
Site area	0.5 acres
Watershed areas (5:1)	2.5 acres
Infiltration rate (untreated)	0.002 ft/day
(treated)	0.0066 ft/day
Time period	15 days
Runoff coefficient	0.2

Direct precipitation

$$P_1 = \frac{1.5 \times 0.5}{12} = 0.0625 \text{ acre ft.}$$

Runoff

$$RO = \frac{1.5 \times 2.5 \times 0.2}{12} = 0.0625 \text{ acre ft.}$$

Total collection in breeding site 0.125 acre ft.

Amount of infiltration:

Untreated

0.002 (ft/day) x 0.5 acres x 15 days = 0.015 acre ft.

Treated

0.0066 (ft/day) x 0.5 acres x 15 days = 0.05 acre ft.

Source: Pfannkuch, 1976

The erratic contour of the moraines noted are characterized by non-integrated drainage patterns in addition to depressions. Here water courses and small streams end in depressions or lakes but fail to reach major rivers.

Upland flat areas such as those found in Dakota County have equally undeveloped drainage systems. In these areas, however, depressions are generally absent and soil infiltration capacity is high. Thus, rainfull percolates evenly into the ground.

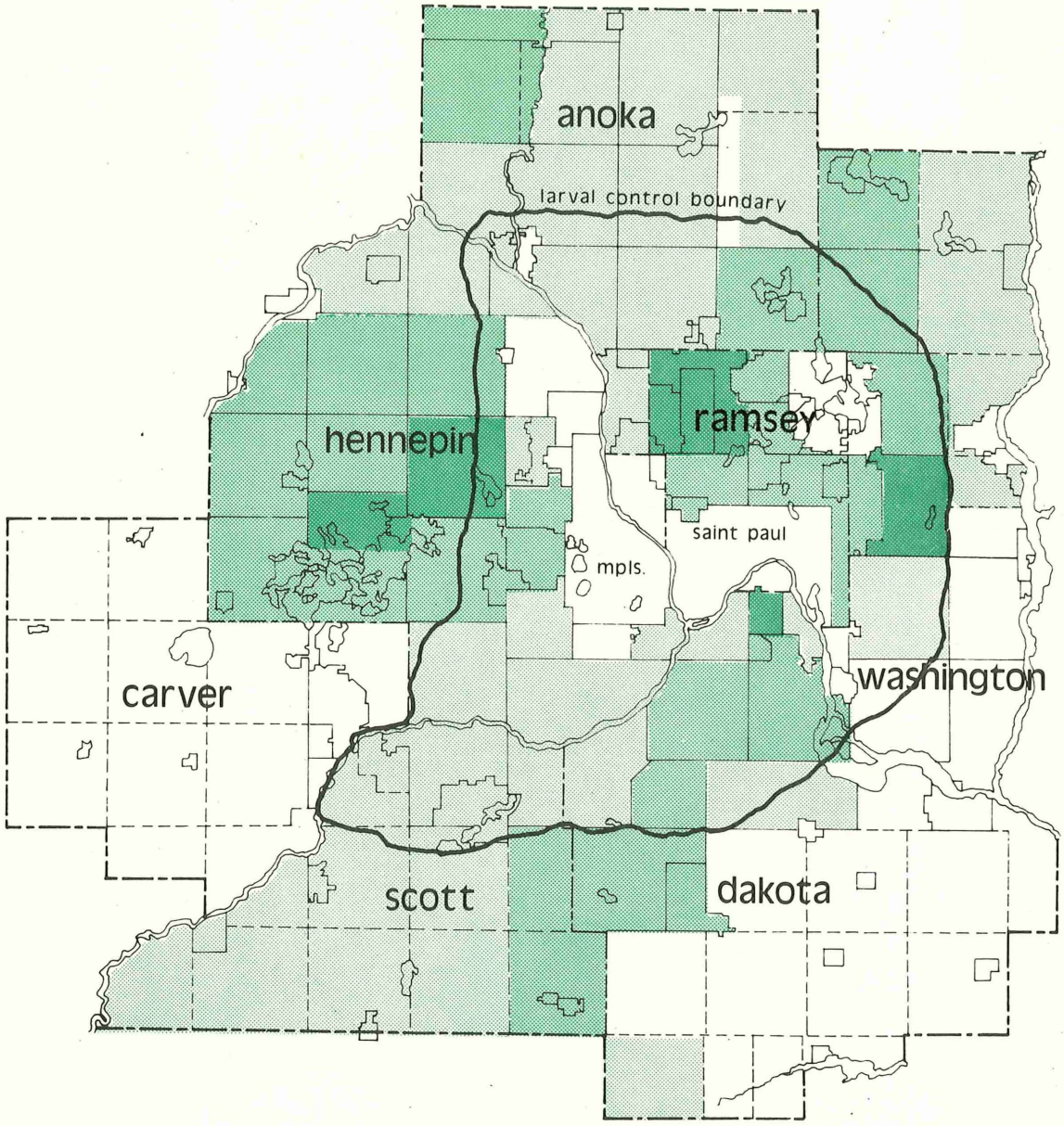
Where there is low density of lakes, there is low density of breeding sites. This relationship is evident in Dakota County, southern Washington County, St. Paul and Minneapolis. The converse phenomenon is evident in areas associated with the Owatonna moraine, and the northwestern part of the St. Croix moraine in northern Washington and Ramsey Counties. These correlations may be seen in a cross reference between figures ES-III and ES-IV.

In addition to physiography, surface hydrology and drainage, ground water geology and hydrology correlate with the establishment of breeding sites and the control of hydrologic factors to affect the density of mosquito breeding areas (depression or surface wetness).

Of particular importance here is the distance from the surface to the watertable and the possible direct hydrologic interconnection between the watertable aquifer and the breeding site.

Where the watertable intersects the topographic surface free-standing water results. In general the watertable is a subdued replica of the topographic surface and therefore is at a greater depth below hills and at a lesser depth below a depression. Thus depth to water is a contributing factor in water collection in an irregular depression topography.

An extreme regional example of this process is the Anoka sand plain. Depth to water in this area is generally very minimal; often the maximum depth is less than 10 feet. As a result two phenomena generally occur. Firstly, water may periodically



number of sites per square mile:

- 0 - 10
- 10 - 25
- 25 - 50
- >50

source: mmcd records, 1974.

figure IV.

density of breeding sites

miles 0 5 10 15 20 n

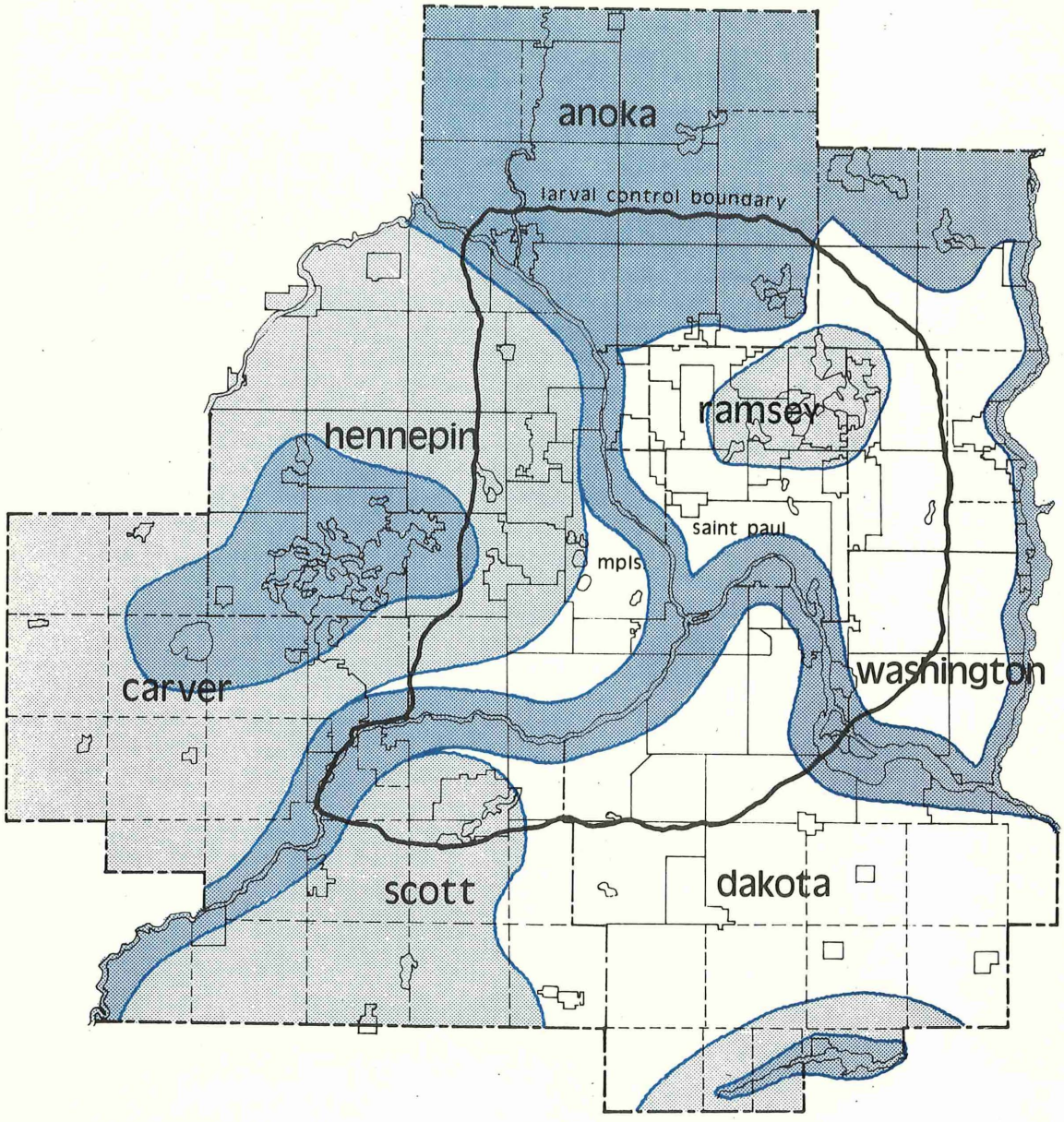
john and michele genereux

rise to the surface due to fluctuations in the watertable. Secondly, the proximity of watertable to land surface means rapid replenishment of any deficit in soil moisture. Soils thus saturated have a diminished capacity for infiltration increasing the likelihood of water retention at the surface.

Conversely, depth to watertable in many parts of Dakota County is relatively great, in the order of 60 to 100 feet. Breeding sites are less dense in this area. The information presented in Figure ES-V generally illustrates this phenomenon.

SOURCE: The foregoing discussion, tables and figures are a composite of materials submitted to the MMCD at the Director's request by:

Dr. Olaf Pfannkuch	-	Hydrologist
Mr. Bruce Watson	-	Climatologist
Dr. Daniel Huff	-	Consultant in Twin Cities Ecology



depth in feet:

deep (>50)

moderate (15-50)

shallow (0-15)

source: Olaf Pfannkuch, 1976.

figure V.

generalized water table depth

miles 0 5 10 15 20

n

john and michele genereux

Table ES-5

Characteristics of Breeding Sites in Regional Townships

ANOKA	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (acres) B.S.	Number of breeding sites per square kilometers	Average size B.S. (acres)	% of acres occupied by B.S.	Number B.S. Type 1	Total acres B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Bethel No.	12.	7680	31.08	155	1802	4.987	11.63	23.46	149	1739.3	11.67	0	0	-	22.64	6	62.8	10.47	0.82
Bethel So.	36	23040	93.24	600	8560	6.435	14.27	37.15	567	8079.3	14.24	32	378.7	11.83	36.71	1	12.	12.00	0.44
Blaine	36	23040	93.24	594	7942	6.371	13.37	34.47	530	5158.1	9.73	64	2783.7	43.49	34.47	0			
Burns	35	22400	90.65	1079	5149	11.903	4.77	22.99	715	3212.1	4.49	355	1831.0	5.15	22.51	9	106	11.78	0.48
Columbus North CA	6.65	4256	17.22	18	1225	1.045	68.06	28.78	10	342.0	34.20	8	833.0	110.37	28.78	0			
Columbus South CA	8	5120	20.72	36	979	1.738	27.19	19.12	26	67.5	2.59	10	911.0	91.1	19.12	0			
Linwood CA	7.65	4896	19.81	19	162	.959	8.53	3.31	11	80.0	7.27	8	81.5	10.18	3.31	0			
Columbus No.	5.35	3424	13.86	60	814	4.329	13.57	23.77	47	775.2	16.49	13	38.5	2.96	23.77	0			
Columbus So.	28.	17920	72.52	372	7299	5.129	19.62	40.73	260	2273.3	8.74	112	5025.3	44.86	40.73	0			
Coon Rapids	22.7	14528	58.79	435	2523	7.399	5.80	17.37	237	1504.0	6.34	198	1019.4	5.14	17.37	0			
Fridley	15.4	9856	39.89	339	793	8.488	2.34	8.05	149	307.7	2.06	190	485.7	2.55	8.05	0			
Grow (Andover)	36	23040	93.24	526	4487	5.641	8.53	19.47	319	3600.5	11.28	193	810.5	4.19	19.14	5	76	15.20	0.33
Ham Lake	34.25	21920	88.21	630	8735	7.142	13.87	39.85	563	8506.5	15.10	67	228.3	3.40	39.85				
Lino Lakes	36	23040	93.24	1239	7751	13.288	6.26	33.64	987	6589.9	6.67	99	1109.0	11.20	33.42	153	52	0.35	0.22
Linwood	28.35	18144	73.43	424	8344	5.774	19.68	45.99	155	2260.1	14.58	269	6083.8	22.61	45.99	0			
Oak Grove	34.6	22144	89.61	789	6017	8.805	7.63	27.17	460	4250.1	9.23	335	1422.3	4.24	25.61	38	345	9.08	1.56
Ramsey	28.8	18432	74.59	694	3690	9.304	5.32	20.02	402	2155.7	5.36	291	1474.1	16.19	19.69	1	60	60.	0.33
St. Francis E.	11.7	7488	30.30	260	2501	8.581	9.62	33.40	152	2176.8	14.32	84	134.0	1.59	30.83	24	190	7.92	2.54
St. Francis W.	12	7680	31.08	397	2184	12.774	5.50	28.44	139	866.8	6.23	258	1317.2	5.10	28.44				
City of Anoka	3.8	2432	9.84	24	73	2.439	3.04	3.00	10	26.5	2.65	12	37.2	3.10	2.63	2	9	4.5	0.37
	438.25	280480	1134. 56	8690	81030	7.66	9.32	28.89	5886	53922.8	9.16	2618	26054.2	9.95	28.51	239	912.8	3.82	.33

Source: MMCD Records as interpreted by Pfannkuch, 1976.

Table ES-5 continued Dakota County

Dakota	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (acres) B.S.	Number of breeding sites per square kilometers	Average size B.S. (acres)	% of acres occupied by B.S.	Number B.S. Type 1	Total acres B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Burnsville	28.	17920	72.52	693	3775	9.56	5.45	21.07	333	1931.5	5.80	237	174.7	.73	11.75	123	1669	13.57	9.32
Castle Rock	36.	23040	93.24	151	1593	1.62	10.55	6.91	146	1589.0	10.88	4	1.0	4.0	6.90	1	3	3.	0.01
Douglas	36.	23040	93.24	79	38	0.85	0.48	.16	77	33.5	.43	2	2.5	1.25	0.16				
Eagan	34.	21760	88.06	1136	2316	12.90	2.04	10.05	981	2086.8	2.12	97	29.4	.30	9.72	58	200	3.45	0.33
Empire	36.	23040	93.24	210	2134	2.25	10.16	9.26	203	2124.1	10.46	4	1.6	.40	9.23	3	8	2.67	0.03
Eureka	36.	23040	93.24	326	2036	3.50	6.25	8.84	307	1963.2	6.39	15	9.8	.65	8.56	4	63	15.75	0.28
Greenvale	30	19200	77.70	533	3330	6.86	6.25	17.34	411	1637.1	3.98	74	63.9	.86	8.86	48	1629	33.94	8.48
Hampton	36.	23040	93.24	155	461	1.66	2.97	2.00	155	461.0	2.79	-	-	-	2.00				
City of Hastings	10.5	6656	26.94	46	319	1.71	6.93	4.79	41	313.6	7.64	4	3.4	.85	4.76	1	2	2.0	0.03
Inver Grove Hgts.	29.5	18880	76.41	1108	1248	14.50	1.13	6.61	948	942.5	.99	91	72.5	.79	5.38	69	233	3.38	1.23
Village of Lakeville	38.	24320	98.42	1068	2247	10.85	2.10	9.24	631	1446.8	2.29	306	188.3	.61	6.72	131	612	4.67	2.52
Apple Valley Village	16.	10240	41.44	477	399	11.51	0.84	3.90	180	123.0	.68	190	85.3	.44	2.03	107	191	1.79	1.87
Marsham	36.	23040	93.24	68	15	0.73	0.22	.07	68	15.0	.22	-	-	-	0.07				
Mendota Hghts.	10.5	6656	26.94	256	1085	9.50	4.24	16.30	244	1050.5	4.30	-	-	-	15.78	12	35	2.92	0.52
Nininger	13.	8320	33.67	41	46	1.22	1.12	.55	33	18.6	.56	3	1.4	.46	0.24	5	26	5.20	0.31
Randolph	10.	6400	25.90	33	62	1.27	1.88	.97	13	9.6	.73	11	8.2	.74	0.28	9	44	4.89	0.69
Ravenna	22.	14080	56.98	83	1988	1.46	23.95	14.12	74	1599.0	21.60	3	1.2	.40	11.36	6	378	63.00	2.76
Rosemount	34.25	21970	88.71	514	659	5.79	1.28	3.01	482	572.2	1.18	11	5.6	.50	2.64	21	101	4.81	0.37
Sciota	15	9600	38.85	57	588	1.47	10.32	6.13	49	494.7	10.09	3	5.3	1.76	5.21	5	88	17.60	0.92
Vermillion	36	23040	93.24	124	222	1.33	1.79	.96	120	205.2	1.71	3	1.8	.60	0.90	1	15	15.0	0.06
Waterford	15.	9600	25.90	128	359	4.94	2.80	3.74	111	325.4	2.93	14	10.6	.75	3.50	3	23	7.67	0.24
West St. Paul	6.	3840	15.54	278	315	17.89	1.13	8.20	272	299.0	1.09	1	3.0	3.0	7.86	5	13	6.50	0.34
South St. Paul	6.34	4058	16.42	140	370	8.53	2.64	9.12	118	293.0	2.48	22	77.0	3.5	9.12	4	9	2.25	0.22
Farmington	11	7040	28.49	56	806	1.97	14.39	11.45	49	802.0	16.37	6	2.0	.33	11.42	1	2	2.00	0.03
	581.09	371820	1491.57	7760	26411	5.20	3.40	7.10	6046	20337.5	3.36	1101	748.5	.68	5.45	617	5344	8.66	1.44

Table ES-5 continued Hennepin County

Hennepin	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (acres) B.S.	Number of breeding sites per square kilometers	Average size B.S. (acres)	% of acres occupied by B.S.	Number B.S. Type 1	Total acres B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Bloomington	44.55	28512	115.38	754	3850	6.53	3.20	13.5	556	3355.7	6.03	171	416.9.	2.43	13.23	27	77	2.85	0.27
Brooklyn Center	8.5	5440	22.02	74	144	3.36	1.95	2.6	62	110.1	1.77	12	33.9	2.82	2.65	0			
Brooklyn Park	27	17280	69.93	309	3401	4.42	11.01	19.7	209	2966.9	14.19	97	432.0	4.45	19.66	3	3	1.00	0.02
Champlin	8.75	5600	22.66	118	570	5.21	4.83	10.2	90	474.8	5.27	27	55.2	2.04	9.46	1	40	40.00	0.71
Corcoran	36	23040	93.24	1532	3810	16.43	2.49	16.5	1325	3745.8	2.82	207	64.2	.31	16.54	0			
Crystal	5.8	3712	15.02	82	146	5.13	1.81	3.7	68	109.6	1.61	9	29.4	3.26	3.74	5	7	1.40	0.19
Dayton	26.	16640	67.34	476	3413	7.07	7.17	20.5	371	3082.3	8.30	97	224.7	2.31	19.87	8	106	13.23	0.64
Deephaven	2.25	1440	5.83	152	269	26.07	1.77	18.7	92	219.3	2.38	60	49.7	.82	18.68	0			
Eden Prairie	36	23040	93.24	812	4879	8.71	6.01	21.2	617	4419.0	7.16	170	333.4	1.96	20.63	25	127	5.08	0.55
Edina	16	10240	41.44	377	1178	9.10	3.12	11.5	318	996.8	3.13	13	9.2	.70	9.82	46	172	3.74	1.68
Excelsior	1.	640	2.59	31	46	14.67	0.74	4.4	38	28.0	.73	0			4.38	3	18	6.00	2.81
Golden Valley	10	6400	25.9	497	640	19.19	1.29	10.0	445	585.6	1.31	21	8.7	.41	9.23	31	49	1.58	0.77
Greenfield	27	17280	69.93	721	2005	10.31	2.78	11.6	542	1832.0	3.38	179	173.0	.96	11.60	0			
Greenwood	.6	384	1.55	21	20	13.55	0.95	5.2	8	7.8	.97	13	12.2	.93	5.21	0			
Hassan	27.	17280	69.93	426	2532	6.09	5.94	14.7	385	2437.8	6.33	39	73.2	1.87	14.53	2	21	10.50	0.12
Hopkins	4.	2560	10.36	78	226	7.53	2.90	8.83	78	226.0	2.90	0				0			
Independence	36	23040	93.24	1052	3642	11.28	3.46	15.8	892	3577.9	4.01	154	58.6	.32	15.78	6	6	1.0	0.03
Long Lake	.8	512	2.07	43	97	20.77	2.26	18.9	24	75.1	3.12	19	21.9	1.15	18.95	0			
Maple Grove	36.	23040	93.24	973	3940	10.44	4.05	17.1	662	3252.8	4.91	298	544.7	1.82	16.48	13	143	11.00	0.62
Medina	27.	17280	69.93	968	3349	13.84	3.46	19.4	847	3303.1	3.89	119	43.6	.36	19.37	2	2	1.0	0.01
Minneapolis	58.9	37696	152.55	171	492	1.12	2.88	1.3	159	383.0	2.40	-	-	-	1.02	12	109	9.08	0.29
Minnetonka	30	19200	77.7	1680	4124	21.62	2.45	21.5	1459	3819.6	2.61	202	276.3	1.36	21.33	19	28	1.47	0.15
Minnetonka Beach	.4	256	1.04	7	11	6.73	1.57	4.3	6	10.80	1.80	1	2.	2.0	4.30	0			
Minnetrista	30.8	19712	79.77	1030	4268	12.89	4.15	21.6	797	4153.4	5.21	231	112.6	.48	21.64	2	2	1.00	0.01

Table ES-5 continued Hennepin County

Hennepin	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (Acres) B.S.	Number of breeding sites per square kilometers	Average size B.S. (acres)	% of acres occupied by B.S.	Number B.S. Type 1	Total acres B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. (acres) Type 1	Total acres B.S. Type 2	Average size B.S. (Acres) Type 2	% of area occupied Type 1 & 2	No. B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type-3 (acres)	% of area occupied Type 3
Mound	4.	2560	10.36	204	335	19.69	1.64	13.1	190	332.2	1.74	14	2.8	.20	13.09	0			
New Hope	5.3	3392	13.73	111	221	8.08	1.99	6.5	89	175.3	1.96	19	28.7	1.51	6.01	3	17	5.67	0.50
Orono	26	16640	67.34	1074	3349	15.95	3.12	20.1	888	3180.7	3.58	180	153.8	.85	20.04	6	14	2.33	0.08
Plymouth	36	23040	93.24	1817	3656	20.56	1.91	15.9	1618	3532.1	2.18	185	92.4	.49	15.73	14	32	2.29	0.14
Richfield	7.1	4544	18.39	47	289	2.28	6.45	5.9	36	257.3	7.14	6	13.7	2.28	5.96	5	18	3.60	0.40
Robbinsdale	2.7	1728	6.99	41	81	5.87	1.98	4.7	33	33.	1.0	8	48.0	6.0	4.69	0			
Shorewood	6	3840	15.54	359	596	23.10	1.66	15.5	196	492	2.51	159	67.0	.42	14.56	4	37	9.25	0.96
Spring Park	2.8	1792	7.25	38	104	5.24	2.74	5.8	38	104	2.73	0			5.80	0			
St. Anthony	2.5	1600	6.48	35	39	5.40	1.11	2.4	25	7.5	.30	1	2.0	2.0	0.63	9	29	3.22	1.81
St. Louis Park	12.7	8128	32.89	369	866	11.22	2.35	10.7	340	827.3	2.43	25	27.7	1.10	10.52	4	11	0.14	2.75
Tonka Bay	1	640	2.59	65	199	24.71	2.80	28.0	29	155.0	5.34	35	24.0	.68	27.97	1	20	20.00	3.13
Wayzata	3.35	2144	8.68	125	430	14.40	3.44	20.1	111	414.1	3.73	14	15.9	1.13	20.06	0			
Woodland	.6	384	1.55	28	78	18.06	2.79	20.3	2	4.3	2.15	24	71.7	2.98	19.79	2	2	0.52	1.0
	610.40	390056	1580.93	16707	57295	10.57	3.43	14.69	13645	52462.0	3.84	2809	3523.1	1.25	14.35	253	1090	4.31	.28

Table ES-5 continued Ramsey County

Ramsey	Area in square miles	Area in acres	Area in square kilometers	Number of breed-sites	Total area (acres) B.S.	Number of breed-ing sites per square kilometers	Average size B.S. (acres)	% of area occupied by B.S.	Number B.S. Type 1	Total area B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No. B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Arden Hills	9.5	6080	24.61	610	960	24.79	1.57	15.8	558	414.7	.74	1	.1	.1	6.83	51	545	10.69	8.96
Little Canada	4.0	2560	10.36	126	204	12.16	1.62	8.0	91	54.8	.60				2.15	35	149	4.26	5.82
Maplewood	15	9600	38.85	575	955	14.80	1.66	9.9	421	103.6	.24	16	8.9	.55	1.18	138	842	6.10	8.77
Moundsview	4.5	2880	11.66	165	404	14.15	2.45	14.0	148	310.8	2.10	3	3.2	1.06	10.90	14	90	6.43	3.13
New Brighton	7.75	4960	20.07	472	657	23.52	1.39	13.2	417	530.2	1.27	27	20.8	.77	11.11	28	106	3.79	2.14
North Oaks	10.25	6560	26.55	422	1739	15.89	4.12	26.5	339	1298.1	3.82	19	57.6	3.03	20.67	64	384	6.0	5.85
North St. Paul	6	3840	15.54	234	368	15.06	1.57	9.6	194	140.1	.72	3	4.0	1.33	3.67	37	227	6.14	5.91
Roseville	15	9600	38.85	457	645	11.61	1.43	6.7	348	230.4	.66	20	63.5	3.17	3.06	83	351	4.23	3.66
Shoreview	11.75	7570	30.43	490	1535	16.10	3.13	20.4	423	707.5	1.67	25	52.2	2.08	10.11	42	775	18.45	10.31
St. Paul	50.25	32160	130.15	600	1974	4.61	3.29	6.1	511	1196.8	2.34	17	53.8	3.16	3.39	72	723	10.04	2.25
Vadnais Heights	9	5760	23.31	385	1771	16.52	4.60	30.7	309	925.5	2.99	5	12.1	2.42	16.28	71	833	11.73	14.46
White Bear Lake	19.5	12480	50.51	666	2212	13.19	3.32	17.7	537	984.0	1.83	12	43.4	3.61	8.23	117	1185	10.3	9.50
	162.50	104050	420.89	5202	13424	12.36	2.58	12.9	4296	6896.5	1.60	148	316.0	2.13	6.93	752	6210	8.26	5.97

Table ES-5 continued Scott County

Scott	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (acres) B.S.	Number of breeding sites per square kilometers	Average size B.S. (acres)	% of area occupied by B.S.	Number B.S. Type 1	Total area B.S... Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No. B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Belle Plaine	29	18560	75.11	622	2652	8.281	4.26	14.29	391	1317.2	3.36	205	257.8	1.25	8.49	26	1077	41.42	5.80
Blakeley	42	26880	108.78	224	2137	2.059	9.54	7.95	173	1807.5	10.44	45	206.5	4.58	7.49	6	123	20.50	.46
Cedar Lake	36	23040	93.24	822	4314	8.816	5.25	18.72	699	3539.6	5.06	92	111.6	1.21	15.85	31	663	20.42	2.87
Credit River	19	12160	49.21	892	2474	18.126	2.77	20.35	643	1882.0	2.92	208	251.8	1.21	17.55	41	340	8.29	2.80
Eagle Creek	39	24960	101.01	868	3148	8.593	3.63	12.61	485	1629.8	3.36	270	266.6	.91	7.73	57	1919	21.39	4.88
Glendale	24	15360	62.16	532	2192	8.559	4.12	14.27	353	1373.9	3.89	150	186.6	1.24	10.16	29	632	21.79	4.11
Helena	36	23040	93.24	586	1442	6.285	2.46	6.26	299	766.9	2.59	270	266.6	.98	4.48	17	409	24.06	1.78
Jackson	10	6400	25.90	226	1295	8.726	5.73	20.23	174	1052.2	6.04	48	85.8	1.78	17.78	4	157	39.25	2.45
Louisville	15	9600	38.95	348	2495	8.958	7.17	25.99	228	1292.3	46.15	93	472.9	5.08	18.39	27	730	27.04	7.60
New Market	36	23040	93.24	1227	2980	13.160	2.43	12.93	1053	2663.0	2.52	159	165.7	1.04	12.28	15	151	10.07	0.65
Sand Creek	34	21760	88.06	792	2821	8.994	3.56	12.96	594	1752.8	2.95	182	491.2	2.69	10.31	16	577	36.06	2.65
Spring Lake	36	23040	93.24	756	2514	8.110	3.33	10.91	534	1567.9	2.93	176	175.9	.99	7.57	46	770	16.74	3.34
St. Lawrence	17	10880	44.03	364	1713	8.267	4.71	15.74	214	1132.0	5.28	135	327.0	2.42	13.41	15	254	16.93	2.33
	373.	238720	966.07	8349	32177	8.64	3.85	13.47	5840	21776.8	3.72	2089	3298.2	1.57	10.50	330	7802	23.64	3.27

Table ES-5 continued Washington County

Washington	Area in square miles	Area in acres	Area in square kilometers	Number of breeding sites	Total area (Acres) B.S.	Number of breeding sites per square kilometers	Average Size B.S. (acres)	% of acres occupied by B.S.	Number B.S. Type 1	Total acres B.S. Type 1	Average size B.S. (acres) Type 1	Number B.S. Type 2	Total acres B.S. Type 2	Average size B.S. (acres) Type 2	% of area occupied Type 1 & 2	No. B.S. Type 3	Total acres B.S. Type 3	Average size B.S. Type 3 (acres)	% of area occupied Type 3
Afton	29	18560	75.11	90	377	1.198	4.19	2.03	72	208.7	2.89	12	146.7	12.22	1.91	6	22	3.67	0.12
Baytown	15	9600	38.85	371	472	9.550	1.27	4.92	312	416.6	1.33	55	28.9	.52	4.65	4	26	6.50	0.27
Cottage Grove	36	23040	93.24	174	378	1.866	2.17	1.64	165	347.7	2.10	3	2.5	.83	1.52	6	28	4.67	0.12
Denmark	34	21760	88.06	55	434	0.625	7.89	1.99	46	414.1	9.0	9	20.2	2.24	1.99	0			
Forest Lake	36	23040	93.24	1289	7093	13.825	5.50	30.79	951	6547.7	6.88	334	530.3	1.58	30.72	4	15	3.75	1.07
Lakeland	15	9600	38.85	126	186	3.243	1.48	1.94	112	171.7	1.53	12	9.6	.80	1.89	2	5	2.5	0.05
Lincoln-Grant	36	23040	93.24	1351	3224	14.490	2.39	13.99	1284	3015.7	2.53	38	56.0	1.47	13.33	29	152	5.24	0.66
May	42	26880	108.78	738	3718	6.784	5.04	13.83	730	3582.0	4.90	1	2.0	2.0	13.33	7	134	19.14	0.50
Newport	14	8960	36.26	171	298	4.716	1.74	3.33	164	290.5	.55	4	3.9	.97	3.28	3	4	1.33	0.05
Oakdale(Lake Elmo)	36	23040	93.24	1660	2329	17.803	1.40	10.11	1371	2094.5	1.52	270	167.7	.62	9.82	19	66	3.47	0.29
Oneka (Hugo)	36	23040	93.24	1009	7479	10.822	7.41	32.46	983	7283.4	7.40	9	12.0	1.33	31.66	17	184	10.82	0.80
New Scandia	42	26880	108.78	821	3642	7.547	4.44	13.55	784	3568.0	4.55	31	57.0	1.83	13.49	6	17	2.83	0.06
Stillwater	24	15360	62.16	314	1193	5.052	3.80	7.77	312	1186.2	3.80	-	-	-	7.72	2	7	3.50	0.05
Woodbury	36	23040	93.24	663	1386	7.111	2.09	6.02	572	1239.9	2.16	82	63.2	.77	5.66	9	83	9.22	0.36
	431	275840	1116.29	8832	32209	7.91	3.65	11.67	7858	30366.0	3.86	860	1100.0	1.27	11.41	114	743	6.52	.27

exhibit b.

MOSQUITOS AND PUBLIC HEALTH

Public health broadly interpreted implies both the clinical control and prevention of disease and the general comfort and safety of individuals or social well-being. Under this broad interpretation, the mosquito poses a threat to public health. Mosquito species common in the Twin Cities area transmit human and animal disease and negatively affect general well-being due to induced annoyance.

There are roughly 95 acres per square mile of mosquito breeding area in the Metropolitan area. As shown in Table ES-6, land uses conducive to mosquito breeding are well distributed throughout the seven county area. Approximately 25% of productive sites coincide with the residential areas of roughly three-fourths of the Metropolitan population.

Although few area residents have contracted diseases borne by mosquitos, many are highly sensitive to mosquito bites. Most are annoyed by mosquito attacks which require protective responses.

Results of a survey conducted by consultants to the MMCD in July-August 1976 indicate that area households spend approximately $3.14 per summer on bug sprays and repellents. Summary survey findings of a Metropolitan Council Survey (1976) show that 3% of area respondents consider the Twin Cities area an undesireable place to live because of mosquitos.

Severe winters, a variety of outdoor recreation opportunities and increased national emphasis upon active use of expanded leisure time encourage outdoor recreation during Minnesota summers. Responses to surveys conducted this year show that even in a season of reduced mosquito production, area residents spend less time outdoors than they would like because of mosquitos.

DISEASES TRANSMITTED BY MOSQUITOS

There are at least 230 arboviruses (arthropod-borne-viruses) of 28 antigenic groups classified according to their ability to multiply in vertebrates (birds)

TABLE ES-6

Ponulation and Land Use Characteristics of the Seven County Metrooolitan Area

County	Population 1970	1974	1974 Pop. Per Sq. Mile	Land Area in Sq. Miles	Number Forty Acre Parcels Forest	Cultivated	Open/ Pasture	Water	Marsh	Urban	Extractive	Transp.
Anoka	154,556	180,300	425.2	424	1611	1,860	1885	323	632	880	2	17
Carver	28,331	33,000	91.9	359	577	3,906	841	281	171	270	2	0
Dakota	139,808	167,100	290.1	576	799	5,719	1758	258	109	898	9	17
Hennepin	960,080	924,800	1631.0	567	722	2,646	1717	617	372	3735	31	71
Ramsey	476,225	461,700	2978.7	155	146	73	392	160	33	1899	4	27
Scott	32,423	37,800	107.1	353	686	3,611	1033	145	185	285	11	0
Washington	82,948	99,700	258.3	386	953	2,775	1855	503	55	734	17	13
Totals	1,874,401	1,904,400	587.1	2,820	5,494	20,690	9,451	2,287	1,557	8,701	76	145
Totals Excluding Carver County		1,871,400	648.7	2,461	4,917	16,684	8,610	2,006	1,386	8,431	74	145

Source: MN. State Planning Agency, 1976

and arthropods (mosquitos) (Hoeprich, 1973). Three mosquito borne encephalitides of Minnesota are: California Encephalitis, St. Louis Encephalitis and Western Equine Encephalitis.

Aedes triseriatus is the principle vector of California or La Crosse Encephalitis, a summertime disease of the central nervous system affecting children between 6 months and 17 years of age.

Locally, early evidence of the disease was confirmed in Winona. Recent urbanization of formerly wooded areas has caused the disease to show itself in the metropolitan area. This phenomenon may be due to improved research as well as population expansion. Five of the 15 cases reported in Minnesota in 1970 were among residents in the Zumbra Ridge area of southwest Hennepin and northeast Carver Counties (Balfour, 1974). Only a small percentage of encephalitis cases are reported, (possibly as low as 10 to 20% comment from Minnesota Department of Health).

Aedes triseriatus breeds in temporary water sites in the basal holes of hardwood trees or in old tires and containers where sufficient water accumulates to allow larvae to develop. These breeding areas make this species difficult to treat with insecticides. In bite counts recorded by the MMCD between 1969-1973 for major pest species, this variety ranked ninth in field bite collections representing 1.3% of the total mosquito population in the metropolitan area. Aedes triseriatus has a short flight range and is generally found near its breeding site.

Like those of other Aedes species, the eggs of this mosquito over-winter. Tests conducted at the University of Minnesota and the University of Wisconsin indicate that infected females transmit the infection to their eggs, thereby perpetuating the disease. Aedes triseriatus normally feeds on squirrels and chipmunks. Humans are incidental hosts. (Watts et al., 1974 and Balfour et al., 1975).

Culex pipiens, a species which occurs at a level of 0.1% of the metropolitan mosquito population, is the principle midwest urban vector of St. Louis Encephalitis. Culex tarsalis is involved in the rural transmission cycle of this virus.

The infection is transmitted to humans by the bite of mosquitos which contract the infection from birds. Older persons are particularly susceptible to this disease. The disease was first recognized in

epidemic proportions in this country during the 1930's. Nearly 2,000 cases (1995) were reported nationally in 1975, one in Minnesota. Screening of suspect cases was conducted by the State Department of Health until 1974. Negative findings prompted suspension of the program until a number of cases were confirmed in Illinois in 1975. The program has been reactivated (Andrews, 1976).

The third arbovirus occuring in the region, Western Equine Encephalitis is transmitted between birds by Culex tarsalis mosquitos. Humans and horses are dead-end hosts in the transmission cycle. Passerine and columbiform birds figure prominently in this cycle.

Culex tarsalis is not a prominent mosquito in Minnesota. During the summer of 1975, a year of particularly high mosquito density, this mosquito accounted for about 11.4% of the Metropolitan mosquito population. The highest recording in the previous nine years was 1.58% made in 1967.

Western Equine Encephalitis was confirmed a major epidemic in Minnesota in 1975 associated with above normal spring rainfall and severe flooding in the Red River Valley. Five cases were reported in humans in the Twin Cities area (Andrews, 1976).

Allergy is a less serious but prevalent health effect related to mosquitos. Any human reaction to a mosquito bite is allergic in nature. Allergens are in the saliva of the mosquito and are introduced into the skin as the mosquito probes and feeds. Reactions can be immediate (whelts appear in a few minutes and disappear within an hour; symptoms appear in a few hours and persist for a few days) or delayed (repetitious reactions at the sites of former feedings appear even weeks later). (Goma, 1966).

Dr. C. A. Frazier, an allergist in North Carolina, has been gathering data, requested in medical journals world wide, from physicians asking for case reports of patients who had severe reactions to biting insects and whether hyposensitization had been attempted. The total number of case reports was 131 and included mosquito bite reactions; 43 out of the 61 patients reportedly had concurrent allergic symptoms. The age of the patients ranged from 2

to 67 years. Fifty-one patients had two or more of the following symptoms to mosquito bites: Generalized urticaria involving two layers of skin, severe pruritis, edema at the bite site. Nausea, headache, dizziness and lethargy were reported in a few cases. Hyposensitization therapy was administered to 37 of the patients; 19 had excellent results, 13 good results, 4 no benefit and 1 was reportedly worse after therapy. Results were rated by the physician as excellent if subsequent bites caused no reaction, or good if reactions were less than before hyposensitization (Frazier, 1974).

Natural desensitization following mosquito bites has long been recognized. Early settlers in this country suffered greatly the first year here but lost their sensitivity later on. Some persons develop seasonal immunity; usually about ten days after onset of mosquito activity, but have reactions the following year although less violently (Frazier, 1974). Often children under one year of age suffer the greatest reactions indicating that as one matures, a natural desensitization does occur (Balfour, 1976).

Two mosquito borne diseases affecting animals in the Twin Cities area are Western Equine Encephalitis and Dirofilariasis. The first found in horses in western and midwestern states. According to the Livestock Sanitary Board the following cases of WEE was reported and confirmed in Minnesota Counties in recent years (Tables ES-7 and ES-8).

WEE is transmitted to horses by the Culex tarsalis mosquito as in humans. The mortality rate is between 15-50% depending upon the strain and virility of the virus (Winters, 1976). The disease is not communicable and treatment is symptomatic and supportive. Tests for disease cost about $10. For these reasons cases are often not reported. Horses contracting the disease are usually valued at between $200-$300. Initial treatments for illness vary between $30-$40. Annual vaccinations cost $10 (Myers, 1976; Winters, 1976).

Table ES-7

Cases of WEE Reported in Minnesota
1968-1976

	Cases	
1968 - 1969	15	
1969 - 1970	1	
1970 - 1971	7	
1971 - 1972	12	
1972 - 1973	140	
1973 - 1974	35	
1974 - 1975	85	
*1975 - 1976	497	(131 confirmed: 19 TC Area)

*High figures for this year reflect a major incidence of WEE in humans in the Red River Valley Region of Minnesota and North Dakota.

Source: Keller, 1976.

Table ES-8

Incidence of WEE in Metropolitan Counties - 1975

	1975	
County	Reported	Confirmed
Anoka	6	3
Carver	1	1
Dakota	11	5
Hennepin	12	7
Ramsey	3	-

Table ES-8, Continued

County	1975 Reported	1975 Confirmed
Scott	5	1
Washington	14	3

Source: Keller, 1976

Dirofilariasis in dogs has had widespread incidence in the Gulf and Eastern Coastal states for many years, however, it is increasingly apparent that it is becoming more prevalent in many parts of the country. In Minnesota, dirofilariasis (heartworm) has been observed in dogs since the mid 1950's, notably in the 7 county metropolitan area with Hennepin County heavily involved. According to several veterinarians in the area, the number of dogs infected with this disease is on the increase. Statistical evidence of cases and deaths is indeterminate since record keeping is not tightly controlled in veterinary clinics and hospitals (Schlotthauer, 1976). In 1974 heartworm was reported in dogs in the following metropolitan communities.

Bloomington	Little Canada
Bryant Lake	Long Lake
Burnsville	Maplewood
Champlin	Minneapolis
Chanhassen	Minnetonka
Chaska	New Brighton
Dayton	North Oaks
Eden Prairie	North St. Paul
Edina	Richfield
Excelsior	Rosemount
Golden Valley	Roseville
Hamel	St. Louis Park
Hopkins	So. St. Paul
Inver Grove Heights	Wayzata
Lake Elmo	White Bear Lake

Heartworm in dogs was first diagnosed locally in 1952 in St. Paul. Between 1950-1960, 301 veterinarians reported 4,164 cases in the state of which 85.9% were diagnosed in Hennepin County. Thirty-six percent of the dogs examined at one clinic in Wayzata were found to have the disease in 1956 (Schlotthauer and Griffiths, 1964).

The etiology of the disease involves microfilariae transmitted by mosquitos of Aedes, Culex, or Anopheles species (in Minnesota). The microfilariae are ingested by a mosquito who serves as an intermediary host; these microfilariae develop into the infective larvae stage in about 2 weeks. The larvae are introduced as the mosquito feeds on the dog and remain in the subcutis, fat, and muscle of the dog for 80-120 days before passing on to the veins and heart where after 4-5 months they become adult worms.

Sexually mature adults begin to produce microfilariae which are passed into the blood and are ingested by mosquitos to continue the cycle of infection. Adult heartworms measure up to 30 cm. in length and live in the pulmonary arteries and right ventricle of the dog's heart; there they accumulate, forming tangled masses which decrease blood supply and cause death (Schlotthauer, 1976; Shupe et al., 1973).

Diagnosis is made by examining blood samples for the Dirofilaria immitis; 5%-20% of the infected dogs may not have this microfilaria in their blood, so other

tests and X-rays must be used if the disease is suspected (Schlotthauer, 1976).

Treatment of heartworm is accomplished with the usage of arsenical drugs to kill the adult worms, supportive therapy of rest, good nursing, and adequate nutrition, and occasionally surgical removal of the worms.

The disease is prevented by mosquito control, annual treatment of dogs to kill developing worms, and preventive oral medication (diethylcarbamazine) before, during and after the mosquito season.

Economics involved with the disease include preventative drugs given annually at a cost of about $5-$18 per dog. If a dog contracts the disease, treatment averages from $45-$100 per dog; this includes diagnosis, laboratory testing, administration of arsenical drugs and boarding.

These cost figures are averages but change depending on factors such as size of the dog and severity of the disease. The loss to the dog owner if the dog dies depends on the value of the dog. Stud dogs earn anywhere from $50-$500 for each mating and can be mated as frequently as once a week placing their value anywhere from $1,000-$25,000 for international show dogs. Most likely, the owners of expensive dogs would take the preventative measures to insure their dogs do not become infected (Brunnel, 1976; Dingel, 1976;Philman , 1976).

Heartworm in cats has been seen rarely but it does occur. Dr. Robert Dingel of the Glen Lake Animal Hospital, has seen four cases of heartworm in cats in the past four years (Dingel, 1976). It is possible that more cats, especially those who spend most of the time outdoors, have the disease but the disease is not suspected with cats and testing is not done.

Dirofilariasis in humans is being studied and 40 cases of human pulmonary and cardiovascular dirofilariasis were confirmed in the U.S. between 1965 - 1975 (Dayaland Neafie, 1975). In the pulmonary cases "coin" lesions of lung were found on Xray, followed by surgical excision and extensive microscopic examination of

the tissue excised. In the cardiovascular cases, the worm was found at autopsy.

Four of the five patients reported to have the pulmonary dirofilariasis have owned dogs, some which had a history of heartworm and some which did not. Despite the frequency of heartworm in dogs, human cases may not be recognized; awareness of the possible occurrence and recognition of the heartworm parasite when it occurs in humans may produce a more complete picture of this disease (Harrison et al., 1965).

exhibit c.

SOCIO-ECONOMIC FACTORS IN MOSQUITO CONTROL

The socio-economic portion of the overall Environmental Impact Statement prepared by the MMCD is emphasized because of the rationale supporting mosquito control in the Twin Cities Metropolitan region--that the mosquito is a pest harmful to human welfare.

It is determined that mosquito control is effective if it allows, with a minimum of interference, for maximum enjoyment of the outdoors by local residents, and thereby contributes to the general well being of residential life in this metropolitan area.

It is further determined, that publicly funded mosquito control is effective if the public costs borne by area residents are substantially lower than private costs of personal control for a maximum level of mosquito reduction.

Finally, mosquito control is determined to be effective if the means used to achieve a high level of mosquito reduction are not themselves harmful to human, animal, aquatic or terrestrial life.

Discussion shall be limited in this section to an analysis of items one and two above in light of alternative programs of the Metropolitan Mosquito Control District.

The information generated and assembled for purposes of this inquiry are of both primary and secondary sources:

1. Data maintained by the District subsequent to its inception in 1958;

2. Data contributed to the study by personnel in other state agencies;

3. Pertinent research findings of area and out-of-state professionals and institutions;

4. Primary light trap and bite count data generated by the MMCD staff during the summer 1976;

5. Primary research conducted by the consultant to the MMCD during the summer, 1976 among Metropolitan residents and recreation area superintendents;

6. Primary research: The findings of the MMCD and its consultant suggesting a predictive model for use in mosquito control programs.

This information was compiled to assess the affect of mosquito presence upon the outdoor behavior of residents in sixteen Metropolitan census tracts located within the MMCD and along its peripheries. The degree of relationship between these two phenomena is assumed to be a measure of the effectiveness of public mosquito control, and the impact of the MMCD program upon residential lifestyles.

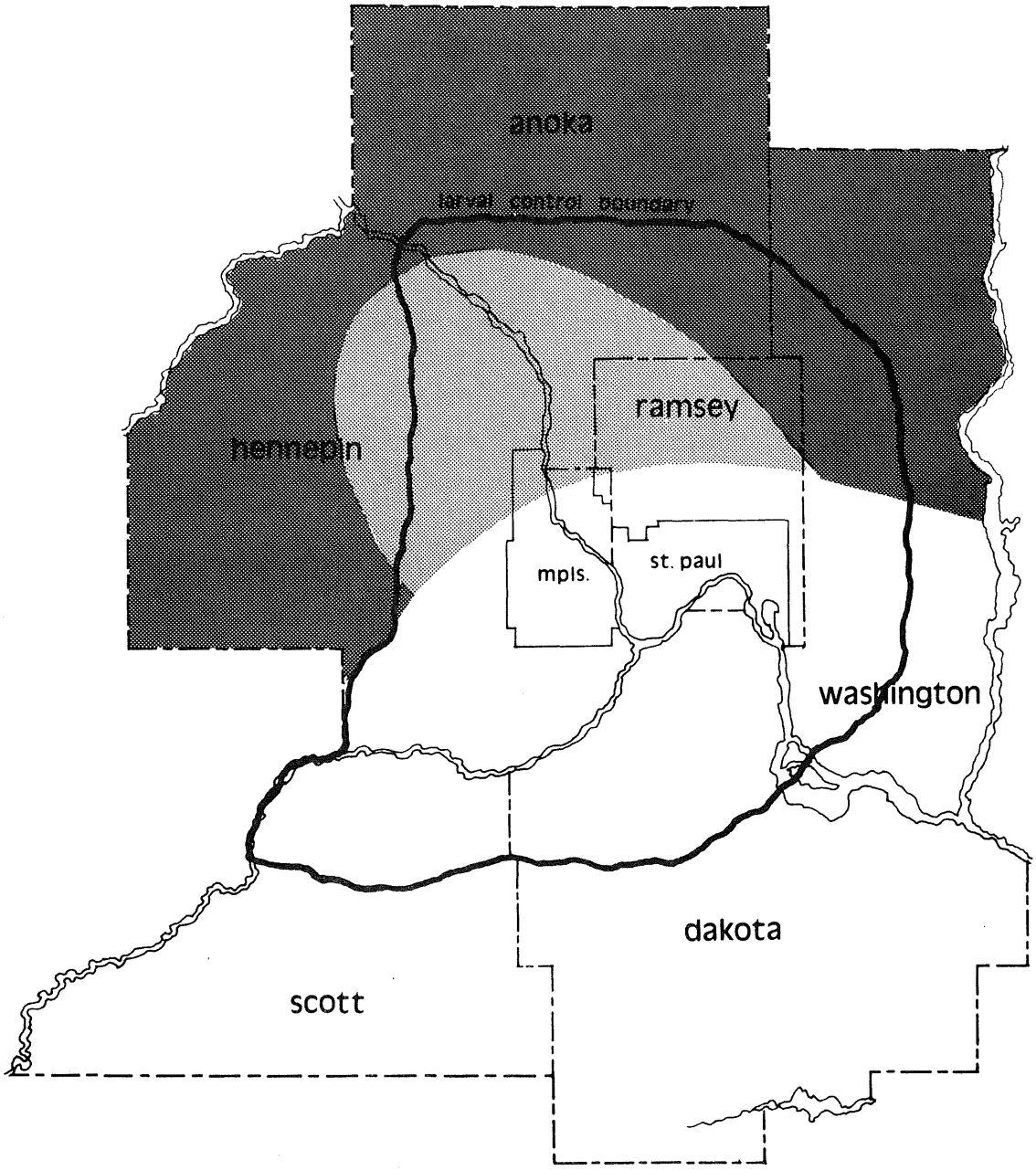
Information was also assembled to assess the cost-effectiveness of the program as measured in the cost differentials between public and private mosquito control to achieve an acceptable residential threshold of annoyance.

Another subject for analysis required a combination of secondary resources and primary research: the impact of the MMCD program upon effective mosquito control in high-use recreation areas.

STUDY PROCEDURE

1. A review of light trap and other historical data compiled by the MMCD was reviewed for the period 1960-1975. Analysis suggested that mosquito density in the District varied geographically. Density variation roughly approximates regions of high, medium and low concentrations similar to those sketched in Figure ES-VI.

2. Based on this knowledge, an assumption was made that the number of hours area residents spend outdoors during the peak mosquito season may vary in the same pattern. Further, it was thought that residents would be the best source for this information.



high density
medium density
low density

source: MMCD light trap records 1960 to 1975.

figure VI.

mosquito density zones

miles 0 5 10 15 20 n

john and michele genereux

3. A three-pronged primary research effort was designed including: 1) a household survey, 2) a park supervisor survey and 3) controlled bite count sites within the survey areas. Each study component was conducted between July 7 and August 30, 1976.

4. Sixteen census tracts were selected within the Metropolitan area for the household survey which satisfied the following selection criteria:

   a. The sites should be geographically dispersed within the area served by the District and along its peripheries;

   b. The sites should be located to conform with the known zones of mosquito density during peak periods of the season;

   c. The sites should be conducive to the effective use of the MMCD bite count and light trap monitoring techniques;

   d. The sites should be comparable in terms of selected socio-economic characteristics and these characteristics should represent those of the Metropolitan SMSA;

   e. The sites should each be within reasonable distance of a public recreation site.

5. To satisfy the requirements of item (d) above, each census tract in the six county metropolitan area comprising the District was reviewed. Tracts chosen for consideration as survey and mosquito monitoring sites were those which deviated from the 1970 Metropolitan SMSA average no more than 25% in the following characteristics:

Item	Metropolitan Average
- Average household size	3.18

Item	Metropolitan Average
- Median value of owner-occupied housing unit	$21,500
- Percent of year round housing units which are single family homes or duplexes	74%

The average population of a census tract in 1970 was 4,000. Those selected for purposes of this study are noted in Figure ES-VII.

6. One hundred twenty randomly selected households were surveyed by phone in each of 16 census tracts for a total of 1920 respondents. Forty households were surveyed in each tract each week for three weeks. Staggered surveying was preferred so as to coincide variances in responses to variance in mosquito density during a portion of the summer between July 26-August 13.

7. During the period June 21-August 8 the MMCD field staff recorded bite counts at five locations within each of the sixteen census tracts (80 sites) on each Monday and Wednesday. A five minute collection was conducted at each site beginning at 9:15 P.M. The starting time was changed to 8:45 after August 1 to coincide with earlier sunset hours.

8. Bite count recording sites were selected to conform to the following criteria:

   a. The site should be located in a residential area;

   b. The site should be located at least 100 feet from a street light or other bright lighting fixture (some species of mosquito, especially *Aedes vexans* are attracted to light);

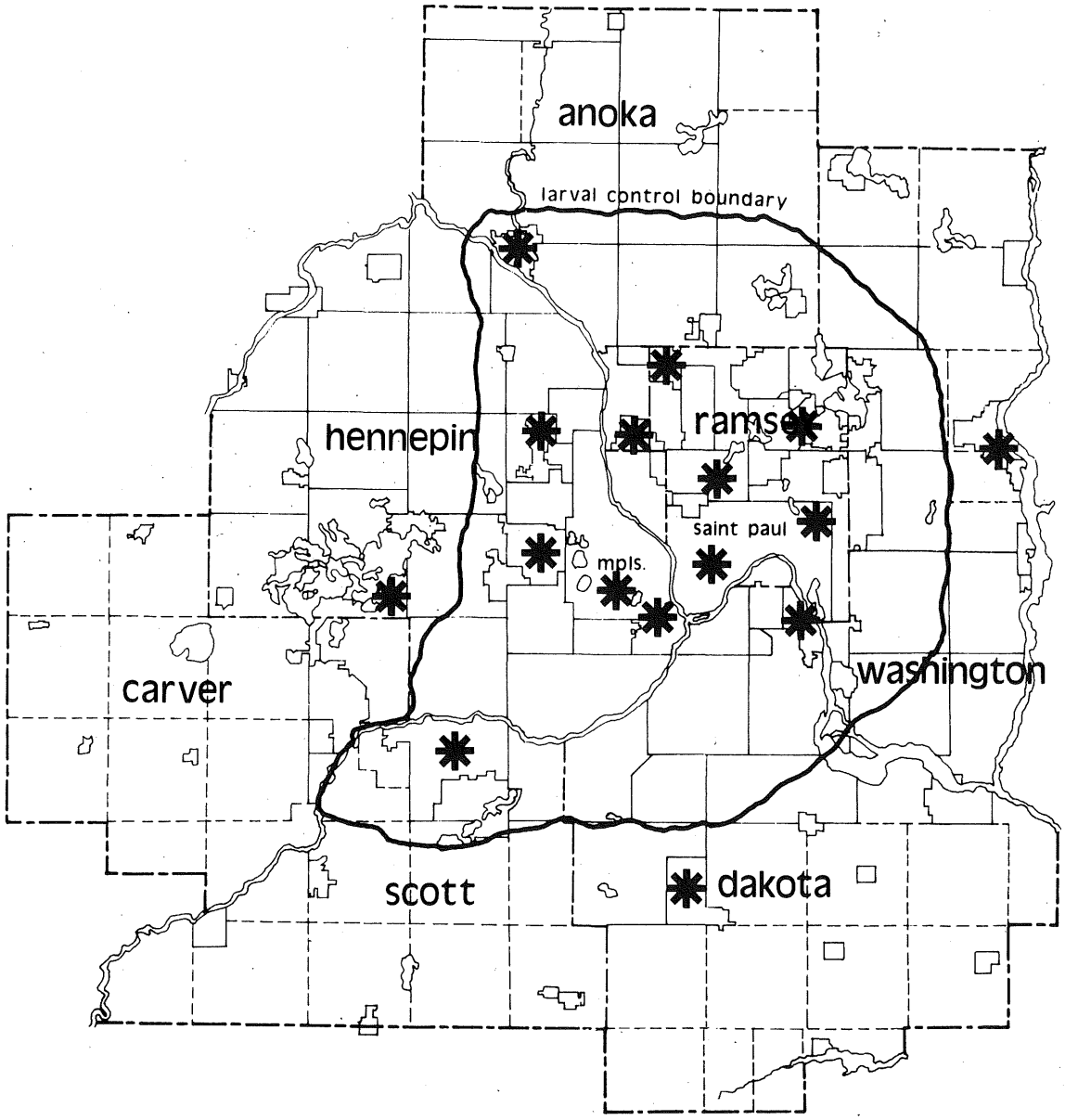


figure VII.

survey locations

summer, 1976

* household survey census tract locations

miles 0 5 10 15 20 n

john and michele genereux

c. The site should be located on a residential street not used by through traffic. Heat, wind or air movement generated by heavy traffic could affect mosquito counts;

d. The site should be located a minimum of 300 feet from heavily wooded areas as these are mosquito harbouring sites;

9. A recorder and a collector conducted the bite count program at each site. Collections were made with an aspirator and asphyxiated in a tube containing chloroform fumes. Each site sample was dated and transferred to the entomology laboratory for species identification.

10. While findings of the household survey and the bite count recordings were being processed a phone survey was conducted among 40 high-use recreation area supervisors in the Metropolitan area. The survey was conducted by the MMCD consultant during the week of August 23rd.

    Subjects of the survey were randomly selected from public and private recreation sites as identified by the Department of Natural Resources in its SCORP inventory and from records maintained by the MMCD identifying controlled recreation sites within the District.

11. The samples were further stratified into different types of outdoor locations. The northern portion of the District, as represented by Ramsey and Anoka Counties, was stressed (15 of 40 respondents), as was the western portion (Hennepin County) with 10, Washington, Dakota, and Scott counties had 6, 6, and 3 respectively.

12. Except as noted, none of the results are statistically significant, due to the small sample size. The chief uses of this study were to complement the household

analysis and gain an indication of benefits that can be assumed. Even large sample sizes would not have overcome certain problems with other questions, especially attendance estimates.

The purpose of this survey was to determine the effectiveness of mosquito control in these sites and to assess supervisor satisfaction with both the level of control and park personnel relationships with District staff.

Master copies of both the household and park supervisor surveys follow.

QUESTIONNAIRE ☐☐☐☐☐☐☐☐☐☐☐☐☐ (1 2 3 4 5 6 7 8 9 10 11 12 13)

I. IDENTIFYING DATA

1. Community Code No. ..... (1-4)
2. Random Sample No. ..... (5-7)
3. Time of Sample ...../...../..... (MO./DAY/HOUR) (8-12)
4. Address .....
5. Phone No. ..... (Name:.....)
6. Single family home ..... (1) Apartment ..... (2) (13)
7. Sex of respondent .....Male (1) .....Female (2) ☐ 14
8. Role of interviewee .....Parent (1) .....Adult in Residence (2) ☐ 15

II. HOUSEHOLD DEMOGRAPHICS

9. How long have you lived at this address? .....years .....months (9.) YEARS ☐☐ 16 17 MOS. ☐ 18
10. Does this home have a screened-in porch .....yes (1) .....no (2) ☐ 19
11. Does this home have a yard .....yes (1) .....no (2) (11.) ☐ 20
12. Is there a wooded area near this home .....yes (1) .....no (2) ☐ 21
13. How many persons normally live in this household ..... (13.) ☐☐ 22 23
14. How many of these persons are under 18..... ☐☐ 24 25

III. OUTDOOR ACTIVITIES OF CHILDREN (persons under 18)

15. How much time have the children in this home spent outdoors after 7 p.m. in the past month?
.....hours .....minutes (15.) HRS. ☐ 26 MIN. ☐☐ 27 28
16. When your children are outdoors, where do they spend most of their time?
(1).....in yours or a neighbor's yard
(2).....in a nearby
(3).....elsewhere ☐ 29

(For the next two statements, please specify how you feel. Do you **strongly disagree** with the statement or **disagree** with the statement? Are you **indifferent** or **undecided**? Do you **agree** with the statement or **strongly agree** with the statement?)

17. The children in this household are frequently bothered by mosquito bites
....strongly disagree (1) .....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) (17.) ☐ 30
18. Mosquitos restrict the length of time the children spend outdoors after 7 p.m.
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 31
19. If there were no mosquitos, how many hours would your children spend outdoors after 7 p.m.
.....hours .....minutes (19.) ☐ 32 ☐☐ 33 34

IV. OUTDOOR ACTIVITIES OF ADULTS

20. How much time have the adults in your household spent outdoors after 7 p.m. on an average evening during the last month? .....hours .....minutes ☐ 35 ☐☐ 36 37

21. When the adults in this household are outdoors, where do they spend most of their time
.....in yours or a neighbor's yard (1)
.....at a nearby park
.....elsewhere (21.) ☐ 38

22. Let's assume for a moment that you are outside for the evening. How many mosquito bites will you put up with before retreating indoors:..... ☐☐ 39 40

23. Let's assume that you are outside at night in your neighborhood for 1 hour. How many mosquito bites would you expect to receive?..... ☐☐☐ 41 42 43

24. How much time would you like to spend outside after 7 p.m. if you were not bothered by mosquitos
.....hours .....minutes ☐☐☐ 44 45 46

(For each of the following statements, please specify how you feel. Do you **strongly disagree** with the statement, or **disagree** with the statement? Are you **indifferent** or **undecided**? Do you **agree** with the statement or **strongly agree** with the statement?)

25. Mosquitos have been a bother during the last month.
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) (25.) ☐ 47

26. Public control of mosquitos is adequate in this neighborhood
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 48

27. More should be done to control mosquitos in this neighborhood
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) (27.) ☐ 49

28. If a higher level of mosquito control could be guaranteed, more public funds should be directed toward mosquito control.
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 50

29. Spraying activities of public mosquito control have interferred with the routine activities of this household.
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 51

30. People in this household have been bothered by the spraying activities of public mosquito control
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 52

31. Spraying to control mosquitoes has a serious negative effect upon the natural environment. (31.)
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 53

32. Even if there were no mosquitos, people in this household would not go outside in the evening for fear of street crime.
....strongly disagree (1) ....disagree (2) ....indifferent/undecided (3)
....agree (4) ....strongly agree (5) ☐ 54

33. Approximately how much money have you spent on mosquito control this summer. (For example, bug sprays, repellents(..... dollars.) ☐☐☐ 55 56 57

34. Over the past few years, which of your family's outdoor activities have been restricted by the presence of mosquitoes? (If none, terminate interview) ☐☐☐☐ 58 59 60 61
☐☐☐☐ 62 63 64 65

35. Which single activity is most important to you? (35.) ☐☐ 66 67

36. On an annual basis, how much would it be worth to you in dollars to be free of mosquitoes during this activity? ☐☐☐ 68 69 70

PARK SUPERVISORS SURVEY

I. Identifying Data

1. County

a. Washington_____

b. Scott_____

c. Hennepin_____

d. Ramsey_____

e. Dakota_____

f. Anoka_____

2. Type

a. Public facility_____

b. Private club and/or specialized facility _____

c. Seasonal event and/or spectator sport _____

d. Private organization areas and/or institution_____

e. Public official area_____

3. Random Sample Number_____

4. Acreage_____

II. History of Mosquito Problems

5. Have mosquitos ever been a problem in this area:

1) Yes_____ 2) No_____

6. If yes, in which years were they a problem.

a. Previous to 1970_____
b. 1971_____
c. 1972_____

d. 1973_____
e. 1974_____
f. 1975_____
g. 1976_____

Which year was the worst?_____

7. Of the following which activities have been effected by the presence of mosquitos especially in that worst year?

a. Biking_____
b. Hiking_____
c. Horseback riding_____
d. Swimming_____
e. Childrens' play_____
f. Picnicking_____
g. Tennis_____
h. Golf_____
i. Jogging_____
j. Group sports_____
k. Walking_____
l. Boating, fishing____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

8. By what percentage have these activities been reduced by the presence of mosquitos in that worst year?

a. Biking ____
b. Hiking_____
c. Horseback riding_____
d. Swimming_____
e. Childrens' play_____
f. Picnicking_____
g. Tennis_____
h. Golf_____
i. Jogging_____
j. Group sports_____
k. Walking_____
l. Boating, fishing_____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

9. Have the mosquito spraying activities of the MMCD interfered with or been a problem for people in the utilization of this recreational area?

1) Yes_____ 2) No_____

If yes, which activities have been affected?

a. Biking_____
b. Hiking_____
c. Horseback riding_____
d. Swimming_____
e. Childrens' play_____
f. Picnicking_____
g. Tennis_____
h. Golf_____
i. Jogging_____
j. Group sports_____
k. Walking_____
l. Boating, fishing_____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

10. Has the mosquito spraying by the district, in your opinion, had a serious negative effect on the natural environment?

1) Yes_____ 2) No_____

If yes, what effect have you noticed?

III. Alternatives

11. Has this area ever had a special individual program of mosquito control? (If no, proceed to question 15).

1) Yes_____ 2) No_____

If yes, when?

a. Previous to 1970?_____
b. 1971_____
c. 1972_____
d. 1973_____
e. 1974_____
f. 1975_____
g. 1976_____

12. What was/is the annual cost of the program?

13. Was/is the program more effective than the current program of the MMCD in terms of the recreational activities mentioned earlier?

1) Yes____ 2) No____ 3) Uncertain_____

14. What materials were used in the program?

a. DDT_____
b. Malathion_____
c. Pyrethrum_____
d. Allethrum_____
e. Detrium_____

15. If the MMCD did not spray would you institute a spraying program yourself?

1) Yes_____ 2) No_____

(If no, proceed to question 18).

16. We have calculated that it would cost_____ for you to spray given current regulation and prices. Does this estimate seem reasonable to you?

1) Yes____ 2) No____ 3) Uncertain____

If no, what would be the cost?_____

17. What program cut-backs would be likely to result from such an expenditure?_____

IV. Program Effectiveness

18. Is a mosquito control program desirable to you?

1) Yes 2) No_____

19. Do you feel that lines of communication with the District are sufficient to provide for prompt solution of mosquito problems?

    1) Yes_____ 2) No_____

20. Do you feel a need for more joint planning with district personnel?

    1) Yes_____ 2) No_____

21. Of the following which program would, in your opinion, ensure mosquito control?

    a. A joint program with the District_____
    b. A totally independent program controlled by you_____
    c. An independent program controlled by the District_____

22. In your observation what % of the people who use this area use repellents when they do so?

    In the daytime_____
    At night_____

23. As currently organized do you think the District is capable of providing the kind of control you would like to see?

    1) Yes_____ 2) No_____

24. Are there any special suggestions you have for improving the District's performance?

25. Which of the following activities occur in this area?

    a. Biking_____
    b. Hiking_____
    c. Horseback riding_____
    d. Swimming_____
    e. Childrens' play_____
    f. Picnicking_____
    g. Tennis_____
    h. Golf_____

i. Jogging_____
j. Group sports_____
k. Walking_____
1. Boating, fishing_____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

26. Can you estimate how many people on the average use this area in a normal week_____

27. How many use the area during the daytime?

_____

28. How many use the area during the evening hours after 7:00 P.M.?_____

29. Can you estimate how many people take part in each activity?

a. Biking_____
b. Hiking_____
c. Horseback riding_____
d. Swimming_____
e. Childrens' play_____
f. Picnicking_____
g. Tennis_____
h. Golf_____
i. Jogging_____
j. Group sports_____
k. Walking_____
1. Boating, fishing_____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

30. How many people take part in each activity during the daytime?

In the evening after 7:00 P.M.?

a. Biking_____
b. Hiking_____
c. Horseback Riding_____
d. Swimming_____
e. Childrens' play_____

f. Picnicking_____
g. Tennis_____
h. Golf_____
i. Jogging_____
j. Group sports_____
k. Walking_____
l. Boating, fishing_____
m. Camping_____
n. Rifle range activity_____
o. Concerts_____
p. Spectator sports_____

STUDY FINDINGS: ENVIRONMENTAL SETTING

Population distribution in the Metropolitan area has been calculated by the Metropolitan Council to reflect a pattern shown in Figure ES-VIII. Distribution patterns have been localized by the Council in terms of rings and sectors which have become familiar to area planners, developers and government departments and are adopted here for convenience.

It should be noted that population is most densely concentrated in what may be referred to as a central core area and older suburbs, rings one and two. Mosquito density occurs most noticeably in outer rings three and four.

A household survey was administered in 16 census tracts within the Metropolitan area to generate information regarding the affects of mosquitos on outdoor behavior of residents which was otherwise not available and considered pertinent to the assessment called for.

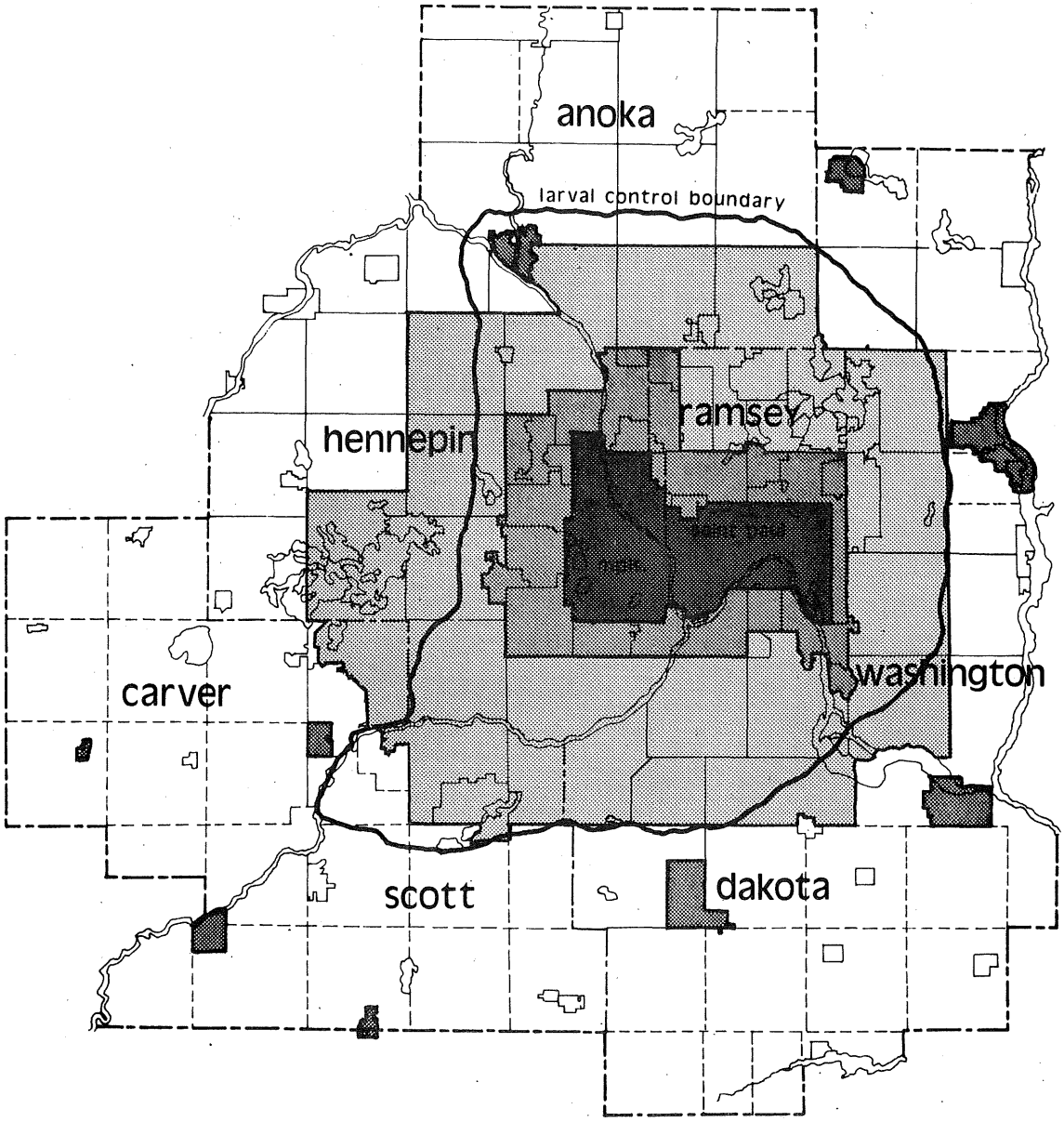
One hundred twenty households were surveyed in each tract (1920 total) ES-VII Computer analysis allows one to conclude the following relationships between mosquito density and outdoor behavior. Organization of findings corresponds to the arrangement of questions in the survey questionnaire presented earlier in this discussion.

I. Household Demographics

1. 89.7% of the survey population live in single family homes, 10.3% live in apartments. As of 1970, 74% of homes in the Metropolitan SMSA were identified as single family dwellings or duplexes.

2. 95% of the survey respondents were adults of whom 80.1% were women.

3. Survey respondents have lived at their current addresses anywhere from one month to 70 years. Median years of residency is 9.8 years, the mean is 12.8 years. Length of residence does not appear to have a significant affect upon the amount of time



general population per square mile:

- high — central cities
- medium — inner ring and free standing communities
- low — developing ring
- lowest — outlying area

source: metropolitan council, twin cities

figure VIII.

population distribution

miles 0 5 10 15 20

N

john and michele genereux

adults spend outdoors in the evening. Although medical studies indicate that immunity or adaptation to mosquitos is a feature of longtime residency, this is not the case among local adult residents. The children of long term residents, however, tend to spend more time out of doors than do the children of newcomers throughout the study area.

4. Approximately 23% of residents in the study areas have screened-in porches; 98% have access to private or common yards and 36% reside in close proximity to heavily wooded areas.

   Forty percent of the households interviewed in the central city portion of Minneapolis and St. Paul have enclosed porches.

   Twice as many inner city homes are equipped with porches than those in outlying areas, thus it is not surprising that the amount of time adults wish to spend outdoors is less in the city than in the suburbs.

II. Outdoor Activities of Children

5. Average household size in the Metropolitan SMSA in 1970 was 3.18. Average mean household size in the survey study area this year is 3.51. Forty-nine percent of the surveyed households have children (under 18 years of age). The population under 18 years of age is 3,014 in the study area. The mean child population varies from .7 per household in a Minneapolis tract to 1.86 in Mounds View. The mean for the study area is 1.13.

6. Since the population of daytime biting mosquitos was considerably lower this year than in years of normal rainfall, questions relating to time spent outdoors were limited to the hours after 7 P.M.

Children in the study area spent an average of two hours (117 minutes) outdoors after 7 P.M. between July 1 and August 15. Eighty-six percent of these children spent this time in either their own or a neighbor's yard. Eight percent frequent nearby parks during the evening hours.

Parks are used more frequently in the central city (8%); older suburbs (8%) and outlying communities (8%) or in rings 1, 2 and 4. Children living in recently settled areas tend to play at home. The telling point is that very few children play in parks after 7 P.M. in the summer.

7. Roughly 25% of the study respondents claim that mosquitos bother their children and limit the amount of time they would normally spend outdoors after 7 P.M. Mosquito density within the study area was most intense in Gem Lake this summer. Forty-four percent of respondents' children in that community were noticeably bothered by Mansonia mosquitos.

   If mosquitos were not a consideration, children in the study would spend an average of 13 minutes more outside after 7 P.M. than they did spend this summer.

III. Outdoor Activities of Adults

8. Households interviewed include 3,373 adults. They would like to spend an average of one hour fifty-three minutes (113 minutes) outdoors after 7 P.M. on a summer evening. This year, they spent an average of one hour twenty-five minutes (85 minutes) outdoors.

   Ninety-two percent (92%) of these adults spend their time outdoors in their own yards. Three percent (3%) use public parks facilities in the evening. Those living in newer suburbs (ring 3) tend to use park slightly more than others (4.6%).

9. According to their own reports, adults living in the study areas have a generally low tolerance for mosquito bites. Tolerance varies from no bites to an infinite number of bites in a few cases. The median number of bites needed to force a person indoors is reported to be 3.

   When asked how many bites the respondent would expect to receive in an average hour spent outdoors at night the median response was 2.5.

10. Only 16% of the respondents felt that mosquitos had been a bother to adults this summer. This probably reflects the abnormally low mosquito population. Respondents noted that in other years their enjoyment of favorite outdoor activities was limited by the presence of mosquitos (44%).

IV. Mosquito Control

11. Fifteen percent (15%) of respondents do not feel that public control of mosquitos is adequate in their neighborhoods; 24% have no opinion and 61% are satisfied with current levels of control.

    Many dissatisfied with current control measures live in Bayport (20%) and St. Louis Park (20%).

    In spite of a general feeling that the program is "adequate," thirty-seven percent (37%) of the study population feel more should be done to control mosquitos in their neighborhoods. Over 50% of the responses from St. Louis Park and Crystal fall into this category. Less than 20% of respondents in South Minneapolis and East St. Paul urge more control.

12. If a higher level of public control could be guaranteed, 64% of all respondents favor increased public expenditures for program expansion.

Responses to this question were uniform throughout the study area, with five notable exceptions. Over 70% of the respondents in Columbia Heights, Gem Lake, Mounds View, St. Louis Park and Crystal support increased funding for increased control.

13. Very few persons report that public spraying activitiesbothers them or interfereswith the routine activities of their households, 3.2% and 2.5% respectively.

14. Nearly one fourth (24%) of all respondents think that spraying to control mosquitos has a serious negative effect on the natural environment. This opinion is geographically dispersed from 42% in Shakopee to 12% in South Minneapolis.

15. According to findings of the Metropolitan Council (Attitude Survey, Summary Report 1976) 33% of Metropolitan residents do not feel safe walking in their neighborhoods after dark.

    Of the population surveyed for this report, 11% indicated they would not go outside in the evening for fear of street crime. Over 20% of the respondents in Columbia Heights and St. Paul (Highland Park Area) share this opinion.

    This question was included for purposes of this study as a control factor. Mosquito control is of little importance to people who do not leave their homes. We are satisfied that although residents may be reluctant to walk city streets at night, they do spend time in their own yards in the evening.

16. Personal mosquito control by area residents is limited primarily to use of commercial bug sprays and repellents and very occasional use of small cold fogging devices. The average household in the study area spent $3.14 this summer on personal control. Twenty-one (21%) percent of those questioned

said that they generally purchased bug sprays, 61% repellents and 18% both.

Cost differentials between tracts and zones of mosquito density have been noted and form an important element in effectiveness analysis of the MMCD program which follows.

17. A hypothetical question (#36) was asked of respondents in an effort to measure thresholds for mosquito annoyance. Responses to this question are presented as an indication of priorities assigned by households to particular outdoor activities according to dollar worth.

Favorite outdoor activities noted by respondents answering this question (44%) include:

Eating outdoors	(17%)
Sitting outdoors	(27%)
Gardening	(14%)
Family sports	(10%)
All: unspecified	(10%)
Water sports	(8%)
Outdoor entertaining	(3%)
Individual sports	(2%)
Walking outdoors	(2%)

Though percentages differed, this rank ordering prevailed throughout the 16 tracts surveyed. Annual worth of enjoying these activities unhampered by mosquitos varied from $.50 to $1,000. Median worth is $9.96; the mean is $28.

MOSQUITO DENSITY IN SIXTEEN METROPOLITAN CENSUS TRACTS 1976

Mosquito bite counts were recorded at 80 sites in the Metropolitan area between July 7 and August 2. Counts for this period were unusually low due to abnormal rainfall. In addition, an abnormal pattern of mosquito density was apparent if at reduced numbers this year. More bites are normally recorded in northern and western sites than elsewhere in the area. Records for 1976 show an average of 2.5 or more bites in a five minute period at Gem Lake, Mounds View, Bayport, and South Minneapolis/Richfield - a random distribution (Table ES-9).

At all other sites in Hennepin County (25) with the exception of one in South Minneapolis, one to two bites were recorded per five minute bite count. Less than one bite per five minute counting period was noted at each remaining site.

An attempt was made to correlate bite counts with reported adjustments in outdoor behavior of adults (as expressed in minutes). The difference between the time adults desire to spend outside and the time they actually spent outdoors this summer is greater than that for children. Adult behavior was isolated for this correlation study.

The percent of time denied adults outdoors has a .44 correlation with mosquito bite counts, giving a regression equation of:

(2.26) x (bite count) + (14.64) = % A time denied

The 95% confidence level for this relationship is given by the formulas:

1) (.6) x (bite count) + (3.66) = % A time denied
2) (3.66) x (bite count) + (17.98) = % A time denied

Both the lower and upper limits correlate positively with high bite counts (as supported in the rest of the data). The regression equation will be used to evaluate past performance and predict future behavior under conditions of alternate M.M.C.D. programs.

TABLE ES-9

Bite Counts Recorded in Five Minute Bite Count Readings
Conducted in Sixteen Metropolitan Census Tracts 1976

	Number of Bite Counts Recorded							
Location	7/7	7/12	7/14	7/21	7/26	7/28	8/2	Average
Anoka	1.2	.40	0	1.0	0	0	0	.371
Columbia Hts.	.8	.2	.2	0	0	.2	.2	.228
Gem Lake	8.0	10.6	9.0	4.6	3.4	4.2	.4	5.742
Roseville	1.8	3.0	2.2	.8	1.0	.6	1.0	1.485
Mounds View	9.6	1.4	2.2	1.8	1.6	2.2	1.2	2.857
Bayport/Oak Park Hts.	7.4	3.6	3.0	1.2	2.6	1.6	0	2.771
East St. Paul	.6	1.6	.6	1.0	.2	0	0	.571
South Mpls.	3.4	.6	1.8	1.0	4.0	2.4	0	2.64
Farmington	.4	.8	.8	1.6	.2	.6	0	.628
Shakopee	1.8	.2	3.4	.6	0	.6	.4	1.000
St. Louis Park	2.2	.8	1.0	.6	1.0	.8	.8	1.028
Tonka Bay/Excelsior	6.2	1.0	1.4	1.4	.2	0	.4	1.514
Crystal	5.0	1.4	1.4	.6	1.2	1.8	.8	1.742
South Mpls.	0	.4	.4	.8	.2	.2	0	.285
Highland Park	0	.2	.8	.4	0	0	0	.2
South St. Paul	.6	0	0	0	2	.0	0	.114

A comment regarding these formulas is in order. The high constant figures (14.64) and (17.98) are probably reflecting the fact that residents of the study area automatically curtail activity outdoors due to a general belief that mosquitos are out there somewhere lying in wait for them.

The relatively low Beta weight means that 90% of A time denied would only be achieved when 33 mosquitos bite the average resident within five minutes.

Bite counts of no more than 5.5 were recorded during the reporting period at any site. Thus there is some danger in using this formula for extremely high bite count ranges. Upper limits of bite counts for averaged years used in effectiveness analysis, however, do not exceed 9.0. Future research may be required to further specify behavior of medium and higher bite count levels; for this analysis, the formulas will be presumed to be sufficiently accurate.

A second correlation crucial to analysis involves the relationship between mean cost of personal mosquito control and bite counts. A correlation of .79 was obtained for the relationship. The regression line for this relationship is given by the formula:

$$(\text{Mean costs}) = (2.07) + (.36) \times (\text{bite count})$$

In deriving the above formula, household expenditures for personal control which exceeded $50 were eliminated (less than 2% of responses).

A second analysis is the relationship between worth of freedom from mosquitos during favorite outdoor activities and bite counts. Incomplete bite count data renders meaning of analysis uncertain at this time. Generally, for those who had had, at some time, an outdoor activity interrupted, a median value of $10 was attached to freedom from annoyance.

The significance of findings discussed above is that for a given change in mosquito bite counts, there will be a corresponding change in amount of time

residents are able to spend outdoors and the amount of money they spend on bug sprays, repellents and other personal mosquito control.

For example, a reduction of 3 mosquitos in five minute bite counts for 500,000 adults means that 6.2 million hours of extra A-time outdoors is permitted during the summer. A little more than $250,000 normally spent on personal control is saved.

exhibit d.

EPA REGISTERED MOSQUITO CONTROL INSECTICIDES SAMPLE LABELS

COMMERCIAL FORMULATIONS:

ABATE is offered as liquid and granular formulations to accommodate the various conditions of use associated with mosquito control operations.

The liquid formulation, an emulsifiable concentrate containing four pounds actual per gallon, is an amber liquid which, when added to water, will emulsify readily and remain physically stable with minimum agitation.

The granular formulations are intended for use where canopy penetration is a problem. These are offered at 1, 2 and 5% formulations. The 1% concentration, based on a sand carrier, has a bulk density of 80-90 pounds per cubic foot. The 1, 2 and 5% formulations, which are available on a Celatom® granular carrier, have a bulk density of 23-27 pounds per cubic foot.

The choice of carrier and formulation is dependent upon the type of application equipment to be used. Field experience indicates that either the sand or Celatom formulation is satisfactory for use in ground equipment, while the Celatom may be preferred for aircraft application.

Odor: ABATE liquid will produce a typical aromatic petroleum odor during spray operations but the odor does not persist.

®Eagle Picher Co.

COMPATIBILITY:

ABATE is generally not combined with other insecticides for control of mosquito larvae.

For application, ABATE should be extended with water or aromatic petroleum solvents containing at least 85 per cent aromatics (such as Panasol AN-2 or HAN-132). The product shows only limited miscibility in fuel oils and such mixtures should be used with caution.

Phytotoxicity: When used at the recommended rates, ABATE has shown no phytotoxicity to vegetation normally associated with areas of mosquito breeding.

FIELD APPLICATIONS:

Mosquitoes: ABATE 4-E is registered for use by the Pesticides Regulation Division, EPA, for the control of mosquito larvae on non-crop lands at the rate of 0.5 to 1.5 fluid ounces (0.016 to 0.048 pounds actual) per acre. The higher rate should be used where there is known organophosphate resistance.

Granular formations are registered for use at rates ranging from 0.05 pounds actual per acre to 0.5 pounds actual per acre. These formulations should be used where canopy penetration of breeding sites is a problem. The higher rates of application (0.2-0.5 pounds actual per acre) are indicated where infested areas are heavily polluted with organic matter. Where the waters are relatively clean, the lower rates should be adequate.

The residual efficacy of ABATE with either formulation is dependent on the types of water involved and the degree of dilution of the insecticide after application. With contained potable water, applications of 1 ppm of ABATE have provided complete control of mosquito larvae for three to four months. Under conditions of practical field usage on tidal marshes, where there is continual breeding in addition to tidal flushing, a single application of ABATE 4-E at 1 fluid ounce per acre has generally provided adequate larvae control for 10 to 14 days.

Applications of ABATE as a winter larvicide have not produced consistent results. Limited data indicate good control if the application is made just prior to or during hatch.

Midges: ABATE granulars are registered for the control of midge larvae at rates ranging from 0.05-0.5 pounds actual per acre. Best results have been obtained at the rate of 0.1-0.2 pounds actual per acre. ABATE 4-E has not generally proven effective for control of midge larvae.

Gnats, Punkies and Sandflies: ABATE 2% Celatom granular is registered for the control of gnat, punkie, and sandfly larvae at rates ranging from 0.1 to 0.2 pounds actual per acre.

Registered uses for ABATE appear on page 11.

REGISTERED USES FOR ABATE 4-E

PEST CONTROLLED	FLUID OUNCES/ACRE*	REMARKS
Mosquito larvae	0.5 to 1.5	Apply as a uniform spray in sufficient water for good coverage. The higher rate should be used in areas known to have phosphate resistant mosquitoes. Repeat applications as necessary. Do not use on crops used for food, forage or pasture.
EPA Reg. No. 241-132		SEE NOTE BELOW

*In clean, open water, 0.5 fluid ounces (0.016 lb. actual) per acre has been effective. Under normal field operating conditions, 1.0 to 1.5 fluid ounces (0.032 to 0.048 of a pound actual) per acre are recommended

REGISTERED USES FOR ABATE GRANULAR FORMULATIONS

PEST CONTROLLED	AREA OF TREATMENT	FORMULATION	AMOUNT PER ACRE	ACTUAL PER ACRE**	REMARKS
Mosquito larvae Midge larvae	Standing water, shallow ponds, lakes, woodland pools and catch basins.	1% Sand and Celatom Granulars	5-10 lbs.	0.05-.1 lb.	SEE NOTE BELOW
		2% Celatom Granular	2.5-5 lbs.	0.05-.1 lb.	
		5% Celatom Granular	2 lbs.	.1 lb.	
	Tidal water, marshes, swamps, and waters high in organic content.	1% Sand and Celatom Granulars	10-20 lbs.	.1-.2 lb.	Do not use on crops used for food, forage or pasture.
		2% Celatom Granular	10 lbs.	.2 lb.	
		5% Celatom Granular	4 lbs.	.2 lb.	
	Highly-polluted waters.	2% Celatom Granular	25 lbs.	.5 lb.	
		5% Celatom Granular	10 lbs.	.5 lb.	
Gnat, punkie, and sandfly larvae	Marshlands, margins of streams, inter-tidal zones of sandy beaches.	2% Celatom Granular	5-10 lbs.	.1-.2 lb.	Apply uniformly by ground or air equipment. Repeat application as necessary.

1% Sand Granulars — EPA Reg. No. 241-174
1% Celatom Granulars — EPA Reg. No. 241-173
2% Celatom Granular — EPA Reg. No. 241-151
5% Celatom Granular — EPA Reg. No. 241-150

**Under conditions of practical field usage on tidal marshes, where waters are relatively clean, 0.05 to 0.1 of a pound actual per acre is recommended.

NOTE:

ABATE products are toxic to birds. Shrimp and crab may be killed at recommended application rates. Do not apply where these are important resources. Do not contaminate water by cleaning of equipment or disposal of wastes.

ABATE liquid applications are toxic to bees and should not be applied when bees are actively visiting the area.

NET CONTENTS GALLONS

SBP-1382® - 40 MF

OIL BASE CONCENTRATE

(Contains 3.34 pounds of actual SBP-1382 per gallon)

A NEW SYNTHETIC PYRETHROID

FOR EFFECTIVE ADULT MOSQUITO CONTROL

To be applied by Mosquito Abatement Districts, Public Health Officials and other trained personnel in Mosquito Control Programs.

ACTIVE INGREDIENTS:	
**(5-Benzyl-3-furyl)methyl 2, 2-dimethyl-3-(2-methylpropenyl)cyclopropanecarboxylate	40.00% w/w
Related compounds	5.45%
Aromatic petroleum hydrocarbons	52.95%
INERT INGREDIENTS:	1.60%
	100.00%

*Cis / trans isomers ratio: max. 30% (±) cis and min. 70% (±) trans.
**U.S. Patent No. 3,465,007.

CAUTION: KEEP OUT OF REACH OF CHILDREN.

Harmful if swallowed. Do not get into eyes or on skin. In case of contact wash thoroughly immediately. Flush contaminated eyes with plenty of water, and get medical attention. Avoid breathing spray mist.

DO NOT STORE NEAR AN OPEN FLAME. This product is combustible. Store at temperatures above 40°F. If exposed to temperatures below 40°F, warm to 80°F by placing in a warm room. Mix well before using.

This product is toxic to fish and birds. Keep out of lakes, streams, or ponds. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment, or disposal of wastes.

CONTAINER DISPOSAL - Crush used containers and bury in non-cropland soil away from water. This concentrate is toxic to fish. Avoid drainage into streams and other water sources.

READ ENTIRE LABEL FOR DIRECTIONS:

For use by only professional or certified applicators or under the supervision of such applicators, for the reduction in annoyance from adult mosquito infestations and as part of a mosquito abatement program.

DIRECTIONS

This concentrate is to be used for adult mosquito control in ground applications with nonthermal or mechanical spray equipment that can deliver spray particles definitely within the aerosol size range and at specified dosage levels.

ULTRA LOW VOLUME APPLICATIONS

For use in nonthermal ULV portable back pack equipment, similar to the Hudson B. P. Mix 4-1/3 fluid ounces of SBP-1382-40 MF with one gallon of light mineral oil of 74 second viscosity. Adjust equipment to deliver fog particles of 18 microns, median mass diameter. Apply at the rate of 8 fluid ounces of finished formulation per acre, as a 50 ft. swath while walking at a speed of 2 m.p.h. This is equivalent to 0.007 pounds of active ingredient per acre.

For truck mounted nonthermal ULV equipment similar to Leco HD mix 12½ fl. ozs. of SBP-1382-40 MF with one gallon of light mineral oil of 74 second viscosity. Adjust equipment to deliver fog particles of 12 microns, median mass diameter. Apply at the rate of 3 fl. ozs. of finished formulation per acre as a 300 foot swath at a truck speed of 5 m.p.h. This is equivalent to 0.007 pounds of active ingredient per acre.

Fog only when air currents are less than 5 m.p.h. It is preferable to fog during early morning and late afternoon when there is less breeze and convection currents are minimal. Arrange to apply the fog in the direction with breeze to obtain maximum swath length and better distribution. Direct spray head of equipment in a manner to insure even distribution of the fog throughout the area to be treated. Avoid prolonged inhalation of fog.

Guide the direction of the equipment so that the discharge nozzle is maintained at a distance of more than six feet from ornamental plants and fifteen feet or more from painted objects. Temperature fluctuations will require periodical adjustment of equipment to deliver the the desired flow rate at the specified speed of travel m.p.h.. This must be maintained to insure the distribution of the proper dosage of finished formulation.

Spray parks, campsites, woodlands, athletic fields, golf courses, swamps, tidal marshes, residential areas and municipalities around the outside of apartment buildings, restaurants, stores and warehouses. Do not spray on cropland, feed or foodstuffs. Avoid direct applications over lakes, ponds and streams.

NOTICE - This concentrate can not be diluted in water. If temperatures in storage falls below 40°F crystallization will occur. Warm container at 80°F until all crystals disappear. Mix well before using. Avoid storing excess formulation in spray equipment tank beyond the period needed for application.

NOTICE - Seller warrants that the product conforms to its chemical description and is reasonable for the purpose stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE expressed or implied, extends to the use of this product contrary to label instructions or under abnormal conditions, or under conditions not reasonably foreseeable to seller and buyer assumes the risk of any such use.

EPA Reg. No. 432-502

E-2992Y-*RD*

S. B. PENICK & COMPANY
A Unit of CPC International Inc.
100 CHURCH STREET - NEW YORK, N.Y. 10007 U.S.A.

DURHAM

DURSBAN* GRANULES 1

ACTIVE INGREDIENTS:

Chlorpyrifos [0, 0-Diethyl 0-(3, 5, 6-trichloro-2-pyridyl) Phosphorothioate]	1.0%
INERT INGREDIENTS:	99.0%
TOTAL	100.0%

* – Dursban ® – Trademark of the Dow Chemical Company.

HOME LAWNS AND OTHER ORNAMENTAL TURF AREAS

DIRECTIONS FOR USE

For control of Chinch Bugs and Sod Webworms infesting home lawns and other ornamental turf areas: apply Dursban Granules 1 uniformly to home lawns and other ornamental and recreational turf grass areas using any hand or power operated gravity or rotary type spreader designed for application of granular materials. Treat when insects first appear at the rate of 100 pounds per acre. To help obtain uniform distribution, apply one-half the required amount of product in one direction, then apply the balance at a right angle. Immediately after application sprinkle the turf with 1300 gallons of water per acre so as to wash the granules into the zone of insect infestation. Consult the following table to determine amounts of Dursban Granules 1 and water needed for smaller sized areas. Re-treat as necessary.

RATES TO USE

Area to be Treated	Pounds of Dursban Granules 1	Gallons of water to sprinkle on turf after treatment
1000 Sq. Ft.	2½	30
5000 Sq. Ft.	12½	150
10700 Sq. Ft.	25	325

USE PRECAUTIONS FOR HOME LAWNS AND OTHER ORNAMENTAL USE AREAS

Keep children and pets off treated areas until this material is washed into the soil and grass is dry.

USE PRECAUTIONS CONTINUED

This product is toxic to fish, birds and other wildlife. Keep out of any body of water. Do not contaminate water by cleaning of equipment or disposal of wastes. Apply this product only as specified on this label.

FOR CONTROL OF MOSQUITO LARVAE

To be applied only by trained personnel of public health organizations, mosquito abatement districts, public mosquito control programs and professional pest control operators.

USE DIRECTIONS

Use Dursban Granules 1 to control mosquito larvae in non-crop areas that serve as breeding sites for these pests. Apply using any hand operated or ground vehicular mounted gravity or rotary type spreader or seeder or with aerial application equipment that will provide uniform distribution of the granules.

FLOODED AREA TREATMENT: Apply uniformly over flood water impoundments whenever mosquito larvae are present. Use Dursban Granules 1 at the rate of 2.5 to 5 pounds per acre. This rate is equivalent to 0.025 to 0.05 pound of active ingredient per acre.

PRE-HATCH TREATMENT: Many mosquito breeding areas are not covered by water during certain months of the year, yet these areas contain mosquito eggs from which larvae will hatch and grow to maturity when flooding occurs. To control these larvae uniformly apply Dursban Granules 1 at the rate of 10 pounds per acre over the known breeding sites prior to the time flooding is expected. This rate is equivalent to 0.1 pound of active ingredient per acre.

CALIFORNIA ONLY: To be used by mosquito control agencies as provided under the contractual agreement with the California Department of Public Health relating to pesticide usage.

CONTAINER DISPOSAL: Dispose of empty container and wastes by burning or by burying in non-croplands away from domestic water supplies.

USE PRECAUTIONS: Dursban Granules 1 is toxic to shrimp, crabs fish and wildlife. Do not apply to water containing valuable crustaceans and fish. Birds feeding on treated areas may be killed. Consult your State Fish and Game Department before using this product. Use this product only as directed on the label.

CAUTION:

May be harmful if swallowed. Avoid eye contact. Wash thoroughly after handling. Wash contaminated clothing before re-use. Flush contaminated eyes with plenty of water and get medical attention if irritation persists. Keep away from food, feedstuffs and domestic water supplies.

NOTE TO PHYSICIAN: Active ingredient is a cholinesterase inhibitor. Treat symptomatically. Atropine is an antidote.

EPA Est. 5481-CA-1
EPA Reg. No. 5481-121-AA Net weight. 50 pounds 0375

AMVAC CHEMICAL CORPORATION
4100 E. WASHINGTON BLVD.
LOS ANGELES, CALIF. 90023

CAUTION!
KEEP OUT OF REACH OF CHILDREN

NOTICE: AMVAC CHEMICAL CORPORATION makes no warranty, express or implied, including the warranties of merchantability and/or fitness for any particular purpose, concerning this material, except those which are contained on AMVAC's label.

DURSBAN M INSECTICIDE

USE DIRECTIONS

PESTS INDOORS: General Information: Use DURSBAN M insecticide to control the pests indicated in the areas listed below by application as a 0.25% or 0.5% chlorpyrifos spray. Use the 0.25% spray to control light infestations and the 0.5% spray to quickly reduce heavy infestations or as directed. To prepare the spray, dilute DURSBAN M with water or with a suitable base oil as shown in the following SPRAY DILUTION CHART. Repeat the treatment as needed.

SPRAY DILUTION CHART

Gallons of Spray Mixture Desired	Fluid Ounces† of DURSBAN M to Use	
	0.25% spray	0.50% spray
Water-base spray:		
1	¾	1½
3	2	4
5	3½	6⅝
10	6¾	13½
Oil-base spray*†:		
1	½	1
3	1½	3
5	2½	5
10	5	10½

†Note: 1 fluid ounce = 2 tablespoonfuls = 6 teaspoonfuls
*Calculated on basis of deodorized kerosene

Note: Where quick knockdown and/or flushing action is desired, dichlorvos (DDVP) or pyrethrins may be added to the spray mixture containing DURSBAN M as directed. For best results, use DURSBAN at a concentration of 0.25% in both water- and oil-base sprays. (On a percentage basis, 1 pint of water base and 1 quart of oil base sprays.) Consult labeling for the dichlorvos or pyrethrins product you plan to formulate the amount needed to give the desired spray concentration. Also read and observe all use and handling precautions for these products.

APPLICATION WITHIN FOOD AREAS OF FOOD HANDLING ESTABLISHMENTS: Limited to Crack and Crevice Treatment Only — Apply a small amount of material as dry into cracks and crevices such as expansion joints between sidewalls and floors of construction or between equipment or bases and the floor, wall voids (not mixing) portions of equipment which house, conceal, or harbor pests. Other areas to be treated include areas adjoining the product onto exposed surfaces or introducing the material into the air. Avoid contamination of food and food processing surfaces.

Application of this product in the food areas of food handling establishments, other than as a crack and crevice treatment, are not permitted.

APPLICATION WITHIN RESIDENTIAL BUILDINGS INCLUDING HOMES AND APARTMENT BUILDINGS AND IN NONFOOD AREAS OF INDUSTRIAL INSTITUTIONAL AND COMMERCIAL BUILDINGS INCLUDING NONFOOD AREAS OF HOSPITALS, STORES, MANUFACTURING PLANTS AND WAREHOUSES:

For Spot Treatment Only — Apply as a coarse spray or with a paint brush to localized areas where cockroaches, occasional invaders or those resistant to certain other insecticides, ants, crickets, firebrats, silverfish, and spiders are found or normally occur including dark corners of rooms and closets, cracks and crevices in walls, floors and ceilings, baseboards, behind sinks, stoves, refrigerators and cupboards, around plumbing and other utility installations. For ants, apply to ant trails, also around doors and windows and wherever else these pests may find entrance. Note: A period of 4 to 7 days is normally required for maximum effect on cockroaches.

For control of brown dog ticks (occasionally apply a 0.5% spray as a spot treatment to infested areas, such as pet beds and resting quarters, nearby cracks and crevices along and behind baseboards, window and door frames and localized areas of floor and floor covering where these pests may be present. Old bedding of pets should be removed and replaced with clean, fresh bedding after treatment. Do not treat pets with this product.

Attention (Pests Indoors): Do not use in poultry houses or other animal buildings. Do not allow spray to contact food, feedstuffs, and water supplies. Thoroughly wash dishes and food handling utensils with soap and water if they become contaminated by application of this product. Do not allow children or pets to contact treated surfaces until spray has dried. Remove pets and cover fish bowls (tanks) before spraying.

PESTS OUT-OF-DOORS: General Information: Use DURSBAN M for control of certain pests of lawns and ornamental plants, for area control of ticks and for mosquito control. Consult the following directions for dosage and application data as to control the pests listed.

Pests of Lawns and other Ornamental and Recreational Turf Grass Areas: Use DURSBAN M as directed to control ants, **brown dog ticks, chinch bugs, crickets, cutworms, earwigs, grasshoppers, sod webworms** (lawn moths). Mix DURSBAN M with water according to directions given in the following table and apply as a coarse, low pressure spray using suitable application equipment. For best results, the lawn should be moist at time of treatment, and care should be taken to obtain complete and uniform coverage of pest infested areas. Spray when pests first appear. Repeat when needed.

DOSAGE and DILUTIONS FOR USE on TURF

Area to be Treated	Amount of DURSBAN M	Dilute with Water to Give
500 sq ft	½ fl oz	15 gal
1,000 sq ft	1 fl oz	30 gal
5,000 sq ft	3½ fl oz	150 gal
10,700 sq ft	½ pint	325 gal
One Acre	1 quart	1,300 gal

To control certain white grubs (larvae of Japanese chafer and Asiatic garden beetle) use twice the amounts of Dursban M shown in the TURF table, i.e., 1 to 3 fl oz per 1,000 sq ft or 1 to 2 qts per acre. Apply in enough water to obtain uniform coverage of area treated, followed immediately by thorough watering to wash the insecticide down into the turf. For best results, treat when grubs are young and actively feeding near the soil surface, usually during late July and August. Consult your local Agricultural Extension Service specialist for proper time to treat in your area.

To control turfgrass (Hyperodes) weevils use twice the amount of DURSBAN M shown in the above TURF table, i.e., ½ pint diluted in 1,300 gal of water per acre. Set by successful pest free areas in mid April and again in mid May. Consult your local Agricultural Extension Service specialist for proper time to treat in your area.

Note: To help prevent migration of earwigs, ants, crickets, earwigs, and sowbugs (pillbugs) treat a band of soil 6 to 10 feet wide around and adjacent to the building, also the building foundation to a height of 2 to 3 feet, where pests are active and may find entrance. Use the same dosage and dilution recommended for control of these pests in turf as shown in the above table. Apply as a coarse spray to thoroughly and uniformly wet the band area.

DOSAGE and DILUTIONS for USE on ORNAMENTAL PLANTS

Pests Controlled	Amount of DURSBAN M in Water to Make		
	3 gallons	10 gallons	100 gallons
Aphids Bagworms Grasshoppers Mites Spittle bugs Whiteflies	0.25 fl oz	0.8 fl oz	0.5 pint*
Cutworms Mealybugs Leafhoppers Thrips (exposed)	0.5 fl oz	1.6 fl oz	1 pint**

*Equivalent to 4 ounces of chlorpyrifos per 100 gallons
**Equivalent to 8 ounces of chlorpyrifos per 100 gallons

Note: Mosquitoes coming to rest on areas treated for control of turf and ornamental plant pests will be killed for varying periods of time after treatment, depending on exposure of treated areas to weathering conditions.

Pests of Ornamentals: Use DURSBAN M to control **aphids, bagworms, cutworms, grasshoppers, leafhoppers, mealybugs, mites, spittlebugs, thrips** (exposed) and **whiteflies** on flowers, shrubs, vines, shade and flowering trees, and evergreens found to be infested with these pests. Dilute DURSBAN M with water according to directions given in the following table and apply, using suitable hand or power spray equipment in a manner to provide complete and uniform coverage of infested plants. Avoid overspraying to the point of excessive runoff. Treat when pests appear and repeat at 7 to 10 day intervals, if needed. **Note** — Do not use on azaleas, camelias, poinsettias, rose bushes, or variegated ivy because of possible injury to these plants.

Attention (Lawn and Ornamental Plant Pests): Keep children and pets off treated areas until spray has dried. Keep out of lawn and garden fishpools and other bodies of water.

Area Control of Ticks: Use DURSBAN M to control ticks infesting nonecropland areas such as recreation footpaths and trails, picnic and camping sites, parks and other recreational areas where these pests are present and create a nuisance or possible public health problem. Apply DURSBAN M in water at the rate of 1 pint per acre (equivalent to 1 fl oz per 2,700 sq ft) using a hydraulic sprayer, mist applicator, knapsack sprayer, or other suitable hand or power spray equipment. Treat low underbrush, grassy areas, weeds and ground surface and debris using enough spray volume to obtain thorough coverage, usually 40 to 100 gallons per acre.

Attention (Area Control of Ticks): Do not allow public use of treated areas during application or until spray has dried.

Mosquitoes: Apply DURSBAN M to mosquito infested, non-crop areas according to the conditions and rates shown in the following table. Mix DURSBAN M with either water or oil such as kerosene or No. 2 fuel oil, using sufficient spray volume to give uniform coverage of area treated. Apply the spray using suitable application equipment such as hand and power ground sprayers, mist applicators, and aerial spray equipment.

CONDITIONS and RATES to USE for MOSQUITO CONTROL

Condition of Area to be Treated	Amount to Use per Acre		Number Acres 1 Gallon of DURSBAN M Will Treat
	DURSBAN M (fluid ounces)	Chlorpyrifos (pounds)	
Larval Control None to medium vegetative cover	0.4 to 0.8	0.0125 to 0.025	320 to 160
Medium to heavy vegetative cover	0.8 to 1.6†	0.025 to 0.05†	160 to 80
Adult Control Light to medium vegetative cover	0.8	0.025	160
Medium to heavy vegetative cover	1.6†	0.05†	80

†The higher dosage will also give faster knockdown and longer residual control where there is little or no vegetative cover.

Warning (Mosquito Control): DURSBAN M is toxic to shrimp, crabs and fish. Do not apply to water containing crustaceans and fish. Consult your State Fish and Game Department before using this product for mosquito control.

ENVIRONMENTAL AND USE PRECAUTIONS

This product is highly toxic to bees exposed to direct treatment or residues on plants. Protective information may be obtained from your Cooperative Agricultural Extension Service.

DURSBAN M also is toxic to fish, birds, and other wildlife. Keep out of lakes, streams, or ponds. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from areas treated.

Do not contaminate water by cleaning of equipment, or disposal of wastes. Do not reuse empty container. Destroy it by perforating or crushing. Bury or discard in a safe place away from water supplies.

Apply this product only as specified on this label.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

U.S. Patent No. 3,244,586

B175

THE DOW CHEMICAL COMPANY

SPECIMEN LA
(BACK)
REDUCED TO

es-69

SPECIMEN LABEL
REDUCED TO 77%

DURSBAN® M

INSECTICIDE

[illegible]

ACTIVE INGREDIENTS:
Chlorpyrifos [O,O-diethyl O-(3,5,6-trichloro-2-pyridyl)phosphorothioate] 41.2%
Aromatic petroleum derivative solvent 29.5%
INERT INGREDIENTS: 29.3%
Contains 4 pounds of chlorpyrifos per gallon
E.P.A. Registration No. 464-368-ZA
E.P.A. Est. 464-MI-1

AGRICULTURAL CHEMICAL

Do Not Ship or Store with Food, Feeds, or Clothing

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.
TRANSLATION: TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

WARNING

KEEP OUT OF REACH OF CHILDREN
MAY BE FATAL IF SWALLOWED
MAY BE ABSORBED THROUGH SKIN
MAY BE INJURIOUS TO EYES AND SKIN
COMBUSTIBLE

Do not take internally. Do not get in eyes or on skin. Wash thoroughly after handling. Wash contaminated clothing before re-use. Flush contaminated eyes with plenty of water and get prompt medical attention. Avoid breathing vapors and spray mist. Avoid spraying food crops. Keep away from food, feedstuffs, and domestic water supplies. Keep container closed. DO NOT USE, POUR, SPILL, OR STORE NEAR HEAT OR OPEN FLAME. Handle concentrate in a ventilated area.

Note to Physician: Chlorpyrifos is a cholinesterase inhibitor. Treat symptomatically. Atropine is an antidote.

[illegible]

86-1192 PRINTED IN U.S.A. IN JANUARY, 1975

REPLACES SPECIMEN LABEL PRINTED IN JULY, 1973

REVISIONS INCLUDE: (1) EPA ESTABLISHMENT NUMBER ADDED (2) AGRICULTURAL CHEMICAL STATEMENT ADDED (3) USE ON APHIDS ADDED (4) APPLICATIONS IN FOOD AND NON-FOOD AREAS ADDED (5) ENVIRONMENTAL AND USE PRECAUTIONS EXPANDED

SMALL GRAINS (Barley, Oats, Rye, Wheat): Armyworms, English Grain Aphids, Grasshoppers, Greenbugs; 1½ to 2 pints. Use higher rate for Armyworm control. Make thorough, full coverage application to hatching areas when nymphs are young. Do not apply within 7 days of harvest.
TOBACCO: Aphids; 2 pints.
TOMATOES Aphids, Spider Mites; 2 pints. Drosophila Flies; 2½ pints. Do not apply within 1 day of harvest.
PASTURE AND RANGE LAND: Aphids, Grasshoppers, Leafhoppers; 1½ to 2 pints in 1 gallon of diesel fuel oil per acre by means of an airplane or a turbine-blower type sprayer. May be applied on day of harvest or grazing.
WASTELANDS, ROADSIDES, SOIL BANK LANDS (Not Grazed): Grasshoppers; 1½ to 3 pints per acre in water for good coverage or in 1 gallon diesel fuel oil per acre by means of an airplane or a turbine-blower type sprayer.
ORNAMENTALS: Aphids, European Pine Shoot Moths, Four-lined Leaf Bugs, Japanese Beetle Adults, Mealybugs, Potato Leafhoppers, Rose Leafhoppers, Scurf / Scale, Spider Mites, Tarnished Plant Bugs, Thrips, White Flies – Use 1½ pints per 100 gallons. Dilute spray (1½ teaspoonsful per gallon). Azalea Scale, Bagworms, Birch Leaf Miner, Boxwood Leaf Miner, Fletcher Scale, Florida Red Scale, Juniper Scale, Magnolia Scale, Oak Kermes, Pine Leaf Scale, Tent Caterpillar – Use 2 pints per 100 gallons dilute spray (2 teaspoonsful per gallon). For Fletcher, Juniper and Oak Kermes Scales, apply when scale crawlers have settled on foliage. CAUTION: Avoid use on certain ferns including Boston, Maidenhair and Pteris, as well as on some species of Crassula.

NOTICE OF WARRANTY

Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

Manufactured by:
HOPKINS AGRICULTURAL CHEMICAL CO.
Madison, Wisconsin 53701

USDA Reg. No. 2393-203 HACCO 1M573

Hopkins

MALATHION

57% Emulsifiable Liquid

Insecticide

CONTAINS CYTHION® INSECTICIDE
THE PREMIUM GRADE MALATHION*
*TRADEMARK OF AMERICAN CYANAMID COMPANY
®REG. TRADEMARK AMERICAN CYANAMID COMPANY

ACTIVE INGREDIENTS:	
Malathion*	57%
Xylene	30%
INERT INGREDIENTS	13%
Total	100%

*O, O-dimethyl phosphorodithioate of diethyl mercaptosuccinate.
One gallon contains five pounds of malathion
U.S.D.A. Reg. No. 2393-203

SAMPLE

CAUTION

KEEP OUT OF REACH OF CHILDREN
HARMFUL IF SWALLOWED

Avoid prolonged breathing of spray mist.
Avoid prolonged or repeated contact with skin. Wash thoroughly after handling.
Do not contaminate food or feed products.
Keep container closed and away from heat, sparks and open flame.
Highly toxic to fish. Do not contaminate any body of water by direct application, cleaning of equipment or disposal of wastes or containers.
Do not reuse container. Destroy when empty.
See side panels for complete use instructions and Notice of Warranty.
Net Contents: gallons

Hopkins Agricultural Chemical Co.
Madison, Wisconsin

OBSERVE THE FOLLOWING USE PRECAUTIONS

Observe use limitations given on the label for specific crops. In order that pesticidal residues on food and forage crops will not exceed tolerances established by the Federal Food and Drug Administration, use only at recommended rates and intervals, and do not apply closer to harvest than specified. Do not apply or allow to drift to areas occupied by unprotected humans or beneficial animals or onto adjoining food, fiber or pasture crops. The grower is responsible for residues on his crops as well as for damages caused by drift from his property to that of others.

To protect bees, do not apply when crops are in bloom. Remove or cover hives if application is necessary during bloom.

Consult State Agricultural Experiment Stations or the State Agricultural Extension Service for additional information, as the timing, number, and rate of applications needed will vary with local conditions.

DIRECTIONS FOR USE

Pour specified amount of this product into nearly filled spray tank. Add balance of water to fill tank. Keep agitator running during filling and spraying operations. If mixture does not mix readily but tends to separate as an oily layer, do not use, as injury to plants may result. Do not combine with wettable powders unless previous use of the mixture has proven physically compatible and safe to plants. ALWAYS thoroughly emulsify this product with at least half of total water before adding wettable powder.

RECOMMENDATIONS

Unless otherwise stated for specific pests, apply at the first sign of infestation and repeat at 7–10 day intervals as needed to maintain control. Dosages are given in pints per acre for use in the following water rates on vegetable and field crops:

Aircraft – 3 - 20 gallons water/acre
Ground – 20 - 100 gallons water/acre

Unless otherwise indicated, dosages are given in pints of Malathion 57% in sufficient water to cover one acre. Thorough, full coverage applications should be made. Begin applications when insects first appear and repeat as necessary.

DIRECTIONS FOR USE

Unless otherwise stated quantities listed are the amount to use per acre in a sufficient quantity of water to give coverage.

ALFALFA, CLOVER: Alfalfa Weevil Larvae, Aphids, Armyworms, Grasshoppers, Lygus Bugs. Potato Leafhoppers, Spider Mites, Spittle-bugs; 1½ to 2 pints. Use higher rate for Armyworm control. Do not apply during bloom. May be applied on day of harvest or grazing.

BEANS: Aphids, Cucumber Beetles, Japanese Beetles, Mexican Bean Beetles, Potato Leafhoppers, Spider Mites; 2 pints. Do not apply within 1 day of harvest.

COLE CROPS (Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Kale, Mustard, Turnip): Aphids, Cabbage Looper, Imported Cabbage Worm; 2 to 3 pints. Do not apply within 3 days of harvest on broccoli and turnip; within 7 days of harvest on other cole crops.

CORN: Aphids, Corn Rootworm Adults, Sap Beetles, Thrips; 1½ pints. Do not apply within 5 days of harvest or forage use. Caution: Injury may occur in the whorl and silk stage.

CUCURBITS (Cucumber, Melon, Pumpkin, Squash): Aphids, Spider Mites, Pickleworms, 2 pints. Cucumber Beetles; 3 pints. Do not apply to Cucurbits unless plants are dry. Do not apply within 3 days of harvest on pumpkins; 1 day of harvest on other cucurbit crops.

GRASS AND CEREAL CROPS (Barnyardgrass, Canary grass, Fescue, Orchard grass, Red top, Timothy and Yellow Foxtail; Barley, Corn, Oats and Wheat): Cereal Leaf Beetle; 1½ pints. Do not apply within 7 days of harvest or forage use on barley, oats and wheat; 5 days of harvest or forage use on corn and grasses.

LETTUCE: Aphids, Cabbage Looper, Leafhoppers, Mites; 3 pints. Do not apply within 14 days of harvest on leaf lettuce; 7 days on head lettuce.

ONIONS: Onion Maggots, Thrips; 2 to 3 pints. Use the heavier rate for onion maggot control and apply when flies first appear. Repeat every 4 days. Do not apply within 3 days of harvest on green onions.

PEAS: Pea Aphid; 2 pints. Do not apply within 3 days of harvest, 7 days if forage is to be fed to livestock.

POTATOES: Aphids, Leafhoppers; 2 pints.

DIRECTIONS FOR USE

General: This CONCENTRATE is designed for dilution with light mineral oil for use in cold aerosol generators which produce a fog in which the big majority of particles are in the 5 to 50 micron range. Diluting oil should have a specific gravity of approx. 0.834 at 60° F and an initial boiling point of 503° F. and end point of 837° F to give optimum particle size. An N.F. grade oil is preferred.

Succesaful applications have been made with:
LECO ULV Cold Aerosol Generator, Model HD
HD Hudson #4712 Back Pack

This CONCENTRATE may be used in mosquito adulticiding programs involving residential and recreational areas, swamps, marshes, overgrown waste areas, roadsides and pastures where adult mosquitoes are present in annoying numbers.

Best results are obtained by application when there is a slight breeze -- 5 miles per hour or less. Fog with the breeze so that wind will carry fog from roads or paths into the area to be treated. Repeat applications as needed to obtain desired reduction in adult mosquito population.

The dosage levels recommended below are effective on most mosquito species however, for adequate control of some species, i.e. Aedes taeniorhynchus in Florida, up to .008 pounds pyrethrins may be necessary.

For Truck Mounted LECO Machine: Objective is to treat terrain with .002 to .0025 pounds of pyrethrins and .010 and .0125 pounds of piperonyl butoxide per acre. Dilute 1 part of PYROCIDE CONCENTRATE with 14 parts (wt.) of oil to give a solution containing 5% pyrethrins plus 25% piperonyl butoxide. Fog this solution with a discharge rate of 2 to 2.25 fluid ounces per minute while machine is moving 5 m.p.h. and pressure is set at 3 lbs./sq. in. Discharge nozzle is positioned approx. 30° above horizontal off side of truck bed. Delivery rate and traveling speed can be varied slightly so long as the basic objective of .002 to .0025 pounds actual pyrethrins per acre is maintained. Use swath width of 300 ft. for acreage calculations.

PYROCIDE®
Mosquito Adulticiding Concentrate for ULV Fogging, F-7088

ACTIVE INGREDIENTS:	100%
Pyrethrins	12%
*Piperonyl butoxide, technical	60%
Mineral oil	28%

*Equivalent to 48% (butylcarbityl) (6-propylpiperonyl) ether and 12% other related compounds.

EPA Reg. No. 1021-1185 EPA Est. 1021-MN-1

For HUDSON Back Pack: Strive for same poundage of pyrethrins and piperonyl butoxide per acre as with LECO. Dilute PYROCIDE CONCENTRATE 1 part plus 17 parts oil (wt.) to give a solution containing .67% pyrethrins plus 3.35% piperonyl butoxide. Fog this solution at the rate of 7 fl. oz. per acre, based on a 50-foot killing swath. The Hudson Back Pack is carried on the back of the individual treating the area. The individual should walk forward approx. 870 ft. during discharge of the 7 fl. oz. This is roughly at the pace of 2 miles per hour.

CAUTION

Keep Out of Reach of Children

Harmful if swallowed. Remove spillage from skin and clothing with warm water and soap.

Note: PYROCIDE CONCENTRATE and dilute sprays from it are toxic to fish. Do not contaminate any body of water with spillage or cleaning solutions containing this concentrate. Do not overdose any swamp area or any area bordering streams or lakes.

Drums may be re-used after thorough cleaning.

Always use clean equipment for diluting PYROCIDE CONCENTRATE so as not to contaminate environment. Be sure spraying equipment is thoroughly clean before use.

Mix CONCENTRATE well in drum before use. Keep container closed when not in use. Store in a cool, dry place.

NOTICE

Seller warrants that the product conforms to its chemical description and is reasonably fit for the purpose stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of merchantability or fitness for a particular purpose, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use. This warranty is in lieu of all other warranties, express or implied, including warranties of merchantability and fitness for a particular purpose.

Manufactured by
McLAUGHLIN GORMLEY KING CO.
8810 TENTH AVENUE NORTH
MINNEAPOLIS, MINN. 55427 U.S.A.

Hopkins

MOSQUITO LARVACIDE 1 C G

FOR CONTROL OF MOSQUITO AND MIDGE LARVAE

Contains 1% ABATE® Insecticide on Celatom

ACTIVE INGREDIENT:	
O,O,O',O'-tetramethyl O,O'-thiodi-p-phenylene phosphorothioate ..	1.0%
INERT INGREDIENTS:	99.0%
TOTAL	100.0%

EPA Reg. No. 2393-223 AA EPA Est No. 2393-WI-1

®Trademark of American Cyanamid Co.

CAUTION

KEEP OUT OF REACH OF CHILDREN

MAY BE HARMFUL IF SWALLOWED

Avoid breathing of dust

Avoid contact with skin

Wash thoroughly after handling

Do not contaminate food or feed products

DIRECTIONS FOR USE

Do not use this product for any uses other than those specified on this label.

For control of mosquito and midge larvae, apply Hopkins Mosquito Larvacide 1C G as specified below:

Areas of Treatment	Lbs. Per Acre
Standing waters, shallow ponds, lakes, woodland pools	5 - 10
Tidal waters, marshes, swamps and waters high in organic content	10 - 20

May be applied as a spot treatment to catch basins and similar areas where mosquitoes may breed.

Apply uniformly and repeat applications as necessary.

Do not use on crops used for food, forage or pasture.

This product is toxic to birds. Keep out of lakes, streams, or ponds. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources. Do not contaminate water by cleaning of equipment, or disposal of wastes. Apply this product only as specified on this label.

Destroy empty bags by burning. Stay away from smoke and fumes.

NOTICE OF WARRANTY

Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

NET WEIGHT 25 POUNDS

HACCO 2.5.3.76

MANUFACTURED BY
Hopkins
agricultural chemical co.
BOX 584 • MADISON, WISCONSIN 53701

Hopkins

LARVACIDE D-1
GRANULAR INSECTICIDE
FOR CONTROL OF MOSQUITO LARVAE

Contains Dursban*

To Be Applied Only by Trained Personnel of Public Health Organizations, Mosquito Abatement Districts, Public Mosquito Control Programs and Professional Pest Control Operators

ACTIVE INGREDIENT:	
Chlorpyrifos [O, O-diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate]	1.0%
INERT INGREDIENTS:	99.0%
TOTAL	100.0%

EPA Reg No 2393-229 AA
EPA Est No 2393-WI-1
*Dursban is a registered trademark of the Dow Chemical Company
U.S. Patent No. 3,244,586

CAUTION

KEEP OUT OF REACH OF CHILDREN

MAY BE HARMFUL IF SWALLOWED

Avoid eye contact. Wash thoroughly after handling. Wash contaminated clothing before re-use. Flush contaminated eyes with plenty of water and get medical attention if irritation persists. Keep away from food, feedstuffs and domestic water supplies.

NOTE TO PHYSICIAN: Active ingredient is a cholinesterase inhibitor. Treat symptomatically. Atropine is an antidote.

USE PRECAUTIONS

Hopkins Larvacide D-1 is toxic to shrimp, crabs, fish and wildlife. Do not apply to water containing valuable crustaceans and fish. Do not apply when weather conditions favor drift from areas treated. Birds feeding on treated areas may be killed. Consult your State Fish and Game Department before using this product. Use this product only as directed on the label.

Do not reuse empty container. Destroy it by burying with waste or burning. Stay away from smoke or fumes.

This product is highly toxic to bees exposed to direct treatment or residues on crops. Protective information may be obtained from your Cooperative Agricultural Extension Service.

USE DIRECTIONS

Use Hopkins Larvacide D-1 granular insecticide to control mosquito larvae in non-crop areas that serve as breeding sites for these pests. Apply using any hand operated or ground vehicular mounted gravity or rotary type spreader or seeder or with aerial application equipment that will provide uniform distribution of the granules.

FLOODED AREA TREATMENT: Apply uniformly over flood water impoundments whenever mosquito larvae are present. Use Hopkins Larvacide D-1 at the rate of 2.5 to 5 pounds per acre. This rate is equivalent to 0.025 to 0.05 pound of active ingredient per acre.

PRE-HATCH TREATMENT: Many mosquito breeding areas are not covered by water during certain months of the year, yet these areas contain mosquito eggs from which larvae will hatch and grow to maturity when flooding occurs. To control these larvae uniformly apply Hopkins Larvacide D-1 at the rate of 10 pounds per acre over the known breeding sites prior to the time flooding is expected. This rate is equivalent to 0.1 pound of active ingredient per acre.

NOTICE OF WARRANTY

Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

NET WEIGHT **25 POUNDS**

HACCO 4.3.76

MANUFACTURED BY Hopkins agricultural chemical co

DOW

SPECIMEN LABEL

DURSBAN* 10 CR

INSECTICIDE

A Controlled Release Formulation Containing Chlorpyrifos For Control of Mosquito Larvae

To Be Applied Only by Trained Personnel of Public Health Organizations, Mosquito Abatement Districts, Public and Governmental Mosquito Control Programs and Professional Pest Control Operators

ACTIVE INGREDIENT:
Chlorpyrifos [O,O-diethyl O-(3, 5, 6-trichloro-2-pyridyl) phosphorothioate] 10.6%
INERT INGREDIENTS: 89.4%
EPA Registration No. 464-517
EPA Est. 464-MI-1

AGRICULTURAL CHEMICAL
Do Not Ship or Store with Food, Feeds, or Clothing

CAUTION
KEEP OUT OF REACH OF CHILDREN
MAY BE HARMFUL IF SWALLOWED
Do Not Take Internally • Wash Throughly After Handling and Before Eating or Smoking • Keep Away from Food, Feedstuffs, and Domestic Water Supplies
NOTE TO PHYSICIAN: Chlorpyrifos is a cholinesterase inhibitor. Treat symptomatically. Atropine is an antidote.

USE DIRECTIONS
Use DURSBAN 10 CR insecticide to control mosquito larvae in standing water, temporary rain pools, intermittently flooded areas, stagnant water, woodland pools, log ponds and similar non-cropland areas that serve as breeding sites for these pests. Apply using any hand operated or ground vehicular mounted gravity or rotary type spreader or seeder that will provide uniform distribution of the pellets.

Flooded Area Treatment: Apply DURSBAN 10 CR insecticide uniformly over flooded areas where mosquito larvae are present using the rates given in the table. These rates are equivalent to 1.5 ppm (parts per million) of chlorpyrifos in the total volume of water treated based on the total amount of chlorpyrifos applied. To determine the volume of water present, measure the length, width and average depth of the impoundment (in feet) and calculate the cubic feet of water (L x W x D). Convert the calculated value to gallons by multiplying by 7.48. DURSBAN 10 CR normally will release chlorpyrifos at a rate that will provide control of early instar larvae for one mosquito breeding season. Retreat previously treated areas only when control is no longer evident as indicated by the presence of 3rd and 4th instar larvae.

Pounds of DURSBAN 10 CR	Gallons of Water
14.1	120,000
11.8	100,000
5.9	50,000
2.9	25,000
1.4	12,000
0.7	6,000

Pre-Hatch Treatment: Many mosquito breeding areas are not covered with water during certain months of the year, yet these areas contain mosquito eggs from which larvae will hatch and develop to adults when flooding occurs. To control these larvae, uniformly apply DURSBAN 10 CR insecticide over known breeding sites prior to flooding using the rates recommended in the table based on the anticipated volumes of water, which are expected to occur.

USE PRECAUTIONS
This product is toxic to fish, birds, and other wildlife. Keep out of lakes, streams, ponds and tidal marshes (except when applied for mosquito larvae control; then use only around the borders of these areas and in shallow water). Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources. Consult your State Fish and Game Agency before applying this product.

Do not contaminate water by cleaning of equipment, or disposal of wastes. Apply this product only as specified on this label.

Dispose of empty containers and wastes by burying in non-crop lands away from domestic water supplies or by burning. If burned, keep out of smoke and fumes.

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instructions, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

U.S. Patent No. 3,244,586

22.68 KG/50 LB

A779

THE DOW CHEMICAL COMPANY
AND SUBSIDIARIES
MIDLAND, MICHIGAN 48640 U.S.A. ZURICH, SWITZERLAND HONG KONG SCC
CORAL GABLES, FLORIDA 33134 U.S.A. SARNIA, ONTARIO, CANADA
*Trademark of THE DOW CHEMICAL COMPANY

86-1390 PRINTED IN U.S.A. IN AUGUST, 1976.

REPLACES SPECIMEN LABEL 86-1390 PRINTED IN JUNE, 1976.
DESTROY PREVIOUS SPECIMEN LABELS.
REVISIONS INCLUDE: CORRECTION OF SPELLING ERROR IN CONTAINER DISPOSAL INSTRUCTIONS.

exhibit e.

PUBLIC LAW 91-516

TO AMEND THE FEDERAL INSECTICIDE FUNGICIDE, AND RODENTICIDE ACT, AND FOR OTHER PURPOSES

"SEC. 3. REGISTRATION OF PESTICIDES.

"(a) Requirement.--Except as otherwise provided by this Act, no person in any State may distribute, sell, offer for sale, hold for sale, ship, deliver for shipment or receive and (having so received) deliver or offer to deliver, to any person any pesticide which is not registered with the Administrator.

"(b) Exemptions.--A pesticide which is not registered with the Administrator may be transferred if--

"(1) the transfer is from one registered establishment to another registered establishment operated by the same producer solely for packaging at the second establishment or for use as a constituent part of another pesticide produced at the second establishment; or

"(2) the transfer is pursuant to and in accordance with the requirements of an experimental use permit.

"(c) Procedure for Registration.--

"(1) Statement Required.--Each applicant for registration of a pesticide shall file with the Administrator a statement which includes--

"(A) the name and address of the applicant and of any other person whose name will appear on the labeling;

"(B) the name of the pesticide;

"(C) a complete copy of the labeling of the pesticide, a statement of all claims to be made for it and any directions for its use;

"(D) if requested by the Administrator, a full description of the tests made and the results thereof upon which the claims are based, except that data submitted in support of an application shall not, without permission of the applicant, be considered by the Administrator in support of any other application for registration unless such other applicant shall have first offered to pay reasonable compensation for producing the test data to be relied upon and such data is not protected from disclosure by section 10(b). If the parties cannot agree on the amount and method of payment, the Administrator shall make such determination and may fix such other terms and conditions as may be reasonable under the circumstances. The Administrator's determination shall be made on the record after notice and opportunity for hearing. If the owner of the test data does not agree with said determination, he may, within thirty days, take an appeal to the federal district court for the district in which he resides with respect to either the amount of the payment, or both. In no event shall the amount of payment determined by the court be less than that determined by the Administrator;

"(E) the complete formula of the pesticide; and

"(F) a request that the pesticide be classified for general use, for restricted use, or for both.

"(2) Data in Support of Registration--The Administrator shall publish guidelines specifying the kinds of information which will be required to support the registration of a pesticide and shall revise such guidelines from time to time. If thereafter he requires any additional kind of information he shall permit sufficient

time for applicants to obtain such additional information. Except as provided by subsection (c) (1) (D) of this section and section 10, within 30 days after the Administrator registers a pesticide under this Act he shall make available to the public the data called for in the registration statement together with such other scientific information as he deems relevant to his decision.

"(3) Time for Acting with Respect to Application.--The Administrator shall review the data after receipt of the application and shall, as expeditiously as possible, either register the pesticide in accordance with paragraph (5), or notify the applicant of his determination that it does not comply with the provisions of the Act in accordance with paragraph (6).

"(4) Notice of Application.--The Administrator shall publish in the Federal Register, promptly after receipt of the statement and other data required pursuant to paragraphs (1) and (2), a notice of each application for registration of any pesticide if it contains any new active ingredient or if it would entail a changed use pattern. The notice shall provide for a period of 30 days in which any Federal agency or any other interested person may comment.

"(5) Approval of Registration.--The Administrator shall register a pesticide if he determines that, when considered with any restrictions imposed under subsection (d)--

"(A) its composition is such as to warrant the proposed claims for it;

"(B) its labeling and other material required to be submitted comply with the requirements of this Act;

"(C) it will perform its intended function without unreasonable adverse effects on the environment; and

"(D) when used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment.

The Administrator shall not make any lack of essentiality a criterion for denying registration of any pesticide. Where two pesticides meet the requirements of this paragraph, one should not be registered in preference to the other.

"(6) Denial of Registration.--If the Administrator determines that the requirements of paragraph (5) for registration are not satisfied, he shall notify the applicant for registration of his determination and of his reasons (including the factual basis) therefor, and that, unless the applicant corrects the conditions and notifies the Administrator thereof during the 30-day period beginning with the day after the date on which the applicant receives the notice, the Administrator may refuse to register the pesticide. Whenever the Administrator refuses to register a pesticide, he shall notify the applicant of his decision and of his reasons (including the factual basis) therefor. The Administrator shall promptly publish in the Federal Register notice of such denial of registration and the reasons therefor. Upon such notification, the applicant for registration or other interested person with the concurrence of the applicant shall have the same remedies as provided for in section 6.

"(d) Classification of Pesticides.--

"(1) Classification for General Use, Restricted Use of Both.--

"(A) As a part of the registration of a pesticide the Administrator shall classify it as being for general use or for restricted use, provided that if the Administrator determines that

some of the uses for which the pesticide is registered should be for general use and that other uses for which it is registered should be for restricted use, he shall classify it for both general use and restricted use. If some of the uses of the pesticide are classified for general use and other uses are classified for restricted use, the directions relating to its general uses shall be clearly separated and distinguished from those directions relating to its restricted uses: Provided however, That the Administrator may require that its packaging and labeling for restricted uses shall be clearly distinguishable from its packaging and labeling for general uses.

"(B) If the Administrator determines that the pesticide, when applied in accordance with its directions for use, warnings and cautions and for the uses for which is registered, or for one or more of such uses, or in accordance with a widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment, he will classify the pesticide, or the particular use or uses of the pesticide to which the determination applies, for general use.

"(C) If the Administrator determines that the pesticide when applied in accordance with its directions for use, warnings and cautions and for the uses for which it is registered, or for one or more of such uses, or in accordance with a widespread and commonly recognized practice, may generally cause, without additional regulatory restrictions, unreasonable adverse effects on the environment, including injury to the applicator,

he shall classify the pesticide, or the particular use or uses to which the determination applies, for restricted use:

"(i) If the Administrator classifies a pesticide, or one or more uses of such pesticide, for restricted use because of a determination that the acute dermal or inhalation toxicity of the pesticide presents a hazard to the applicator or other persons, the pesticide shall be applied for any use to which the restricted classification applies only by or under the direct supervision of a certified applicator.

"(ii) If the Administrator classifies a pesticide, or its uses, restricted, out of a determination that its use without additional regulatory restriction may cause unreasonable adverse effects on the environment, the pesticide shall be applied for any use to which the determination applies only by or under the direct supervision of a certified applicator, or subject to such other restrictions as the Administrator may provide by regulation. Any such regulation shall be reviewable in the appropriate court of appeals upon petition of a person adversely affected filed within 60 days of the publication of the regulation in final form.

"(2) Change in Classification. If the Administrator determines that a change in the classification of any use of a pesticide from general use to restricted use is necessary to prevent unreasonable adverse effects on the environment, he shall notify the registrant of such pesticide of such determination at least 30 days before making the change and shall publish the

proposed change in the Federal Register. The registrant, or other interested person with the concurrence of the registrant, may seek relief from such determination under section 6(b).

"(e) Products with Same Formulation and Claims.--Products which have the same formulation, are manufactured by the same person, the labeling of which contains the same claims, and the labels of which bear a designation identifying the product as the same pesticide may be registered as a single pesticide; and additional names and labels shall be added to the registration by supplemental statements.

"(f) Miscellaneous

"(1) Effect of Change of Labeling or Formulation.--If the labeling or formulation for a pesticide is changed, the registration shall be amended to reflect such change if the Administrator determines that the change will not violate any provision of this Act.

"(2) Registration Not a Defense.--In no event shall registration of an article be construed as a defense for the commission of any offense under this Act: Provided, That as long as no cancellation proceedings are in effect registration of a pesticide shall be prima facie evidence that the pesticide, its labeling and packaging comply with the registration provisions of the Act.

"(3) Authority to Consult Other Federal Agencies.--In connection with consideration of any registration or application for registration under this section, the Administrator may consult with any other Federal agency.

"SEC. 4. USE OF RESTRICTED USE PESTICIDES; CERTIFIED APPLICATORS.

"(a) Certification Procedure.--

"(1) Federal Certification.--Subject to paragraph (2), the Administrator shall prescribe standards for the certification of applicators of pesticides. Such standards shall provide that to be certified, an individual must be determined to be competent with respect to the use and handling of pesticides, or to the use and handling of the pesticide or class of pesticides covered by such individual's certification.

"(2) State Certification.--If any State, at any time, desires to certify applicators of pesticides, the Governor of such State shall submit a State plan for such purpose. The Administrator shall approve the plan submitted by any State, or any modification thereof, if such plan in his judgment--

"(A) designates a State agency as the agency responsible for administering the plan throughout the State;

"(B) contains satisfactory assurances that such agency has or will have the legal authority and qualified personnel necessary to carry out the plan;

"(C) gives satisfactory assurances that the State will devote adequate funds to the administration of the plan;

"(D) provides that the State agency will make such reports to the Administrator in such form and containing such information as the Administrator may from time to time require; and

"(E) contains satisfactory assurances that State standards for the certification of applicators of pesticides conform with those standards prescribed by the Administrator under paragraph (1).

Any State certification program under this section shall be maintained in accordance with the State plan approved under this section.

"(b) State Plans.--If the Administrator rejects a plan submitted under this paragraph, he shall afford the State submitting the plan due notice and opportunity for hearing before so doing. If the Administrator approves a plan submitted under this paragraph, then such State shall certify applicators of pesticides with respect to such State. Whenever the Administrator determines that a State is not administering the certification program in accordance with the plan approved under this section, he shall so notify the State and provide for a hearing at the request of the State, and, if appropriate corrective action is not taken within a reasonable time, not to exceed ninety days, the Administrator shall withdraw approval of such plan.

"SEC. 5. EXPERIMENTAL USE PERMITS.

"(a) Issuance.--Any person may apply to the Administrator for an experimental use permit for a pesticide. The Administrator may issue an experimental use permit if he determines that the applicant needs such permit in order to accumulate information necessary to register a pesticide under section 3. An application for an experimental use permit may be filed at the time of or before or after an application for registration is filed.

"(b) Temporary Tolerance Level.--If the Administrator determines that the use of a pesticide may reasonably be expected to result in any residue on or in food or feed, he may establish a temporary tolerance level for the residue of the pesticide before issuing the experimental use permit.

"(c) Use Under Permit.--Use of a pesticide under an experimental use permit shall be under the supervision of the Administrator, and shall be subject to such terms and conditions and be for such period of time as the Administrator may prescribe in the permit.

"(d) Studies.--When any experimental use permit is issued for a pesticide containing any chemical

or combination of chemicals which has not been included in any previously registered pesticide, the Administrator may specify that studies be conducted to detect whether the use of the pesticide under the permit may cause unreasonable adverse effects on the environment All results of such studies shall be reported to the Administrator before such pesticide may be registered under section 3.

"(e) Revocation.--The Administrator may revoke any experimental use permit, at any time, if he finds that its terms or conditions are being violated, or that its terms and conditions are inadequate to avoid unreasonable adverse effects on the environment.

"(f) State Issuance of Permits.--Notwithstanding the foregoing provisions of this section, the Administrator may, under such terms and conditions as he may be regulations prescribe, authorize any State to issue an experimental use permit for a pesticide. All provisions of section 4 relating to State plans shall apply with equal force to a State plan for the issuance of experimental use permits under this section.

"SEC. 6. ADMINISTRATIVE REVIEW; SUSPENSION.

"(a) Cancellation After Five Years--

"(1) Procedure.--The Administrator shall cancel the registration of any pesticide at the end of the five-year period which begins on the date of its registration (or at the end of any five-year period thereafter) unless the registrant, or other interested person with the concurrence of the registrant, before the end of such period, requests in accordance with regulations prescribed by the Administrator that the registration be continued in effect: Provided, That the Administrator may permit the continued sale and use of existing stocks of a pesticide whose registration is canceled under this subsection or subsection (b) to such extent, under such conditions, and for such uses as he may

specify if he determines that such sale or use is not inconsistent with the purposes of this Act and will not have unreasonable adverse effects on the environment. The Administrator shall publish in the Federal Register, at least 30 days prior to the expiration of such five-year period, notice that the registration will be canceled if the registrant or other interested person with the concurrence of the registrant does not request that the registration be continued in effect.

"(2) Information.--If at any time after the registration of a pesticide the registrant has additional factual information regarding unreasonable adverse effects on the environment of the pesticide, he shall submit such information to the Administrator.

"(b) Cancellation and Change in Classification.--If it appears to the Administrator that a pesticide or its labeling or other material required to be submitted does not comply with the provisions of this Act or, when used in accordance with widespread and commonly recognized practice, generally causes unreasonable adverse effects on the environment, the Administrator may issue a notice of his intent either--

"(1) to cancel its registration or to change its classification together with the reasons (including the factual basis) for his action, or

"(2) to hold a hearing to determine whether or not its registration should be canceled or its classification changed.

Such notice shall be sent to the registrant and made public. The proposed action shall become final and effective at the end of 30 days from receipt by the registrant, or publication, of a notice issued under paragraph (1), whichever occurs later, unless

within that time either (i) the registrant makes the necessary corrections, if possible, or (ii) a request for a hearing is made by a person adversely affected by the notice. In the event a hearing is held pursuant to such a request or to the Administrator's determination under paragraph (2), a decision pertaining to registration or classification issued after completion of such hearing shall be final.

"(c) Suspension.--

"(1) Order.--If the Administrator determines that action is necessary to prevent an imminent hazard during the time required for cancellation or change in classification proceedings, he may, by order, suspend the registration of the pesticide immediately. No order of suspension may be issued unless the Administrator has issued or at the same time issues notice of his intention to cancel the registration or change the classification of the pesticide.

"Except as provided in paragraph (3), the Administrator shall notify the registrant prior to issuing any suspension order. Such notice shall include findings pertaining to the question of 'imminent hazard.' The registrant shall then have an opportunity, in accordance with the provisions of paragraph (2), for an expedited hearing before the Agency on the question of whether an imminent hazard exists.

"(2) Expedite hearing.--If no request for a hearing is submitted to the Agency within five days of the registrant's receipt of the notification provided for by paragraph (1), the suspension order may be issued and shall take effect and shall not be reviewable by a court. If a hearing is requested, it shall commence within five days of the receipt of the request for such hearing unless the registrant and the Agency agree that it shall commence at a later time.

The hearing shall be held in accordance with the provisions of subchapter II of title 5 of the United States Code, except that the presiding officer need not be a certified hearing examiner. The presiding officer shall have ten days from the conclusion of the presentation of evidence to submit recommended findings and conclusions to the Administrator, who shall then have seven days to render a final order on the issue of suspension.

"(3) Emergency order.--Whenever the Administrator determines that an emergency exists that does not permit him to hold a hearing before suspending, he may issue a suspension order in advance of notification to the registrant. In that case, paragraph (2) shall apply except that (i) the order of suspension shall be in effect pending the expeditious completion of the remedies provided by that paragraph and the issuance of a final order on suspension, and (ii) no party other than the registrant and the Agency shall participate except that any person adversely affected may file briefs within the time allotted by the Agency's rules. Any person so filing briefs shall be considered a party to such proceeding for the purposes of section 16(b).

"(4) Judicial review.--A final order on the question of suspension following a hearing shall be reviewable in accordance with Section 16 of this Act, notwithstanding the fact that any related cancellation proceedings have not been completed. Petitions to review orders on the issue of suspension shall be advanced on the docket of the courts of appeals. Any order of suspension entered prior to a hearing before the Administrator shall be subject to immediate review in an action by the registrant or other interested person with the

concurrence of the registrant in an appropriate district court, solely to determine whether the order of suspension was arbitrary, capricious or an abuse of discretion, or whether the order was issued in accordance with the procedures established by law. The effect of any order of the court will be only to stay the effectiveness of the suspension order, pending the Administrator's final decision with respect to cancellation or change in classification. This action may be maintained simultaneously with any administrative review proceeding under this section. The commencement of proceedings under this paragraph shall not operate as a stay of order, unless ordered by the court.

"(d) Public Hearings and Scientific Review.--In the event a hearing is requested pursuant to subsection (b) or determined upon by the Administrator pursuant to subsection (b), such hearing shall be held after due notice for the purpose of receiving evidence relevant and material to the issues raised by the objections filed by the applicant or other interested parties, or to the issues stated by the Administrator, if the hearing is called by the Administrator rather than by the filing of objections. Upon a showing of relevance and reasonable scope of evidence sought by any party to a public hearing, the Hearing Examiner shall issue a subpena to compel testimony or production of documents from any person. The Hearing Examiner shall be guided by the principles of the Federal Rules of Civil Procedure in making any order for the protection of the witness or the content of documents produced and shall order the payment of reasonable fees and expenses as a condition to requiring testimony of the witness. On contest, the subpena may be enforced by an appropriate United States district court in accordance with the principles stated herein. Upon the request of any party to a public hearing and when in the Hearing Examiner's judgment it is necessary or desirable, the Hearing Examiner shall at any time before the

hearing record is closed refer to a Committee of the National Academy of Sciences the relevant questions of scientific fact involved in the public hearing. No member of any committee of the National Academy of Sciences established to carry out the functions of this section shall have a financial or other conflict of interest with respect to any matter considered by such committee. The Committee of the National Academy of Sciences shall report in writing to the Hearing Examiner within 60 days after such referral on these questions of scientific fact. The report shall be made public and shall be considered as part of the hearing record. The Administrator shall enter into appropriate arrangements with the National Academy of Sciences to assure an objective and competent scientific review of the questions presented to Committees of the Academy and to provide such other scientific advisory services as may be required by the Administrator for carrying out the purposes of this Act. As soon as practicable after completion of the hearing (including the report of the Academy) but not later than 90 days thereafter, the Administrator shall evaluate the data and reports before him and issue an order either revoking his notice of intention issued pursuant to this section, or shall issue an order either canceling the registration, changing the classification, denying the registration, or requiring modification of the labeling or packaging of the article. Such order shall be based only on substantial evidence of record of such hearing and shall set forth detailed findings of fact upon which the order is based.

"(e) Judicial Review.--Final orders of the Administrator under this section shall be subject to judicial review pursuant to section 16.

"SEC. 7. REGISTRATION OF ESTABLISHMENTS.

"(a) Requirement.--No person shall produce any pesticide subject to this Act in any State unless the

establishment in which it is produced is registered with the Administrator. The application for registration of any establishment shall include the name and address of the establishment and of the producer who operates such establishment.

"(b) Registration.--Whenever the Administrator receives an application under subsection (a), he shall register the establishment and assign it an establishment number.

"(c) Information Required.--

"(1) Any producer operating an establishment registered under this section shall inform the Administrator within 30 days after it is registered of the types and amounts of pesticides--

"(A) which he is currently producing;

"(B) which he has produced during the past year; and

"(C) which he has sold or distributed during the past year.

The information required by this paragraph shall be kept current and submitted to the Administrator annually as required under such regulations as the Administrator may prescribe.

"(2) Any such producer shall, upon the request of the Administrator for the purpose of issuing a stop sale order pursuant to section 13, inform him of the name and address of any recipient of any pesticide produced in any registered establishment which he operates.

"(d) Confidential Records and Information.--Any information submitted to the Administrator pursuant to subsection (c) shall be considered confidential and shall be subject to the provisions of section 10.

"SEC. 8. BOOKS AND RECORDS.

"(a) Requirements.--The Administrator may prescribe regulations requiring producers to maintain such records with respect to their operations and the pesticides and devices produced as he determines are necessary for the effective enforcement of this Act. No records required under this subsection shall extend to financial data, sales data other than shipment data, pricing data, personnel data, and research data (other than data relating to registered pesticides or to a pesticide for which an application for registration has been filed).

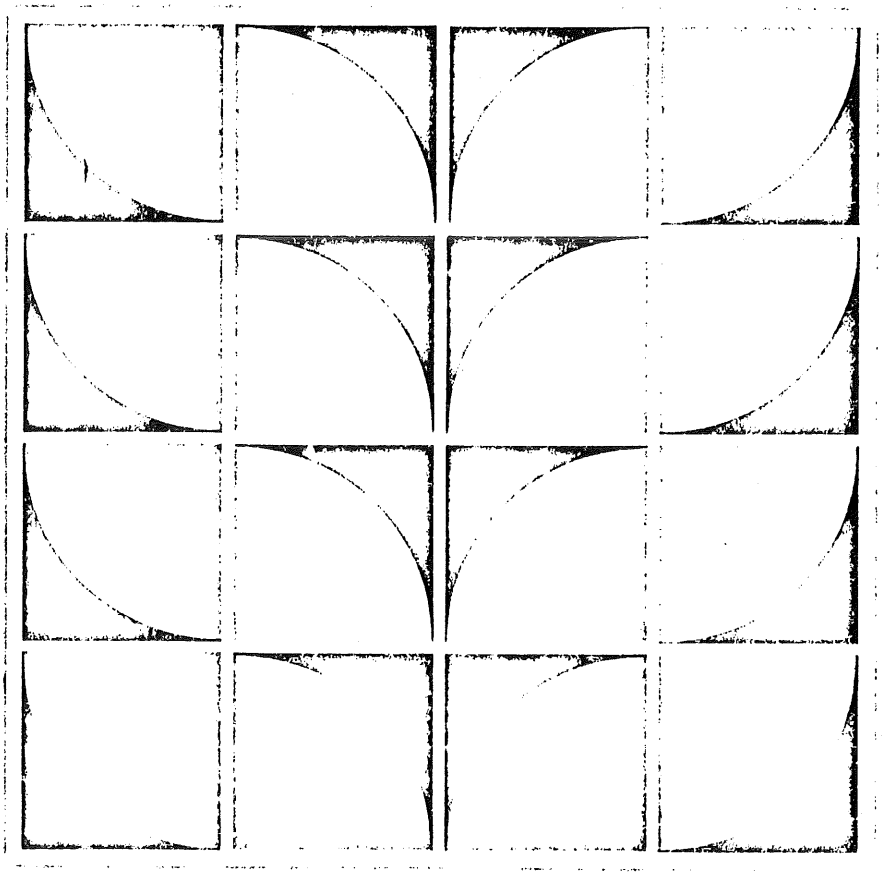
"(b) Inspection.--For the purposes of enforcing the provisions of this Act, any producer, distributor, carrier, dealer, or any other person who sells or offers for sale, delivers or offers for delivery any pesticide or device subject to this Act, shall, upon request of any officer or employee of the Environmental Protection Agency or of any State or political subdivision, duly designated by the Administration, furnish or permit such person at all reasonable times to have access to, and to copy: (1) all records showing the delivery, movement, or holding of such pesticide or device, including the quantity, the date of shipment and receipt, and the name of the consignor and consignee; or (2) in the event of the inability of any person to produce records containing such information, all other records and information relating to such delivery, movement, or holding of the pesticide or device. Any inspection with respect to any records and information referred to in this subsection shall not extend to financial data, sales data other than shipment data, pricing data, personnel data, and research data (other than data relating to registered pesticides or to a pesticide for which an application for registration has been filed) . . . ."

Apply Pesticides Correctly

A guide
for commercial
applicators

U.S. Department
of Agriculture

U.S. Environmental
Protection Agency



Using Pesticides Safely

There are two good reasons for using pesticides safely:

- to keep yourself and other people from being poisoned, and
- to avoid harming the environment.

Protecting Man

How Pesticides Harm Man

Pesticides can cause injury. They are *toxic*. Manufacturers find out how toxic a pesticide is by testing it on animals. The product's *hazard*—the danger that injury will occur to man—depends on the toxicity of the active ingredient plus the exposure to the product during use.

Most pesticides can cause severe illness, or even death, if misused. But every registered pesticide can be used safely if you use proper care.

Children under 10 are the victims of at least half of the accidental pesticide deaths in this country. If pesticides were always cared for correctly, children would never touch them.

Many accidental pesticide deaths are caused by eating or drinking the product. But some mixers, loaders, and applicators die or are injured when they breathe a pesticide vapor or get a pesticide on their skin. Repeated exposure to small amounts of some pesticides can cause sudden severe illness.

Most pesticides can enter the body through the skin. You may get more into your body this way than you would accidentally swallow or inhale while working. With some pesticides, skin contact alone can cause death.

You should help prevent *all* accidents with pesticides:

- by using and storing pesticides away from children and other untrained persons, and
- by taking care to follow directions when using them.

Products for restricted use need special care. The label is your guide.

Symptoms of Pesticide Poisoning

You should know what kinds of sickness are caused by the pesticides you use. You also should know the conditions under which each one may make you sick.

There are two kinds of clues to pesticide poisoning. Some are feelings that only the person who has been poisoned can notice—such as nausea or headache. These are *symptoms*. Others, like vomiting, also can be noticed by someone else. These are *signs*. So you should know:

- what your own feelings might mean, and
- what signs of poisoning to look for in your co-workers and others who may have been exposed.

All pesticides in the same chemical group cause the same kind of sickness. This sickness may be mild or severe, depending on the pesticide and the amount absorbed. But the *pattern* of illness caused by one type of pesticide is always the same. Having some of the signs and symptoms does not always mean you have been poisoned. Other kinds of sickness may cause similar signs and symptoms. Headache and a feeling of being unwell, for example, may signal the start of many kinds of illness. It is the *pattern of symptoms* that makes it possible to tell one kind of sickness from another.

Get medical advice quickly if you or any of your fellow workers have unusual or unexplained symptoms starting at work or later the same day. If you suspect a person has been poisoned, do not leave him alone. Do not let yourself or anyone else get dangerously sick before calling your physician or going to a hospital. It is better to be too cautious than too late. Take the container (or the label) of the pesticide to the physician. Do not carry the pesticide container in the passenger space of a car or truck.

Synthetic Organic Pesticides

Organophosphates—These pesticides injure the nervous system. The signs and symptoms go through stages. They normally occur in this order:

Mild Poisoning
- fatigue
- headache
- dizziness
- blurred vision
- too much sweating and salivation
- nausea and vomiting
- stomach cramps or diarrhea

Moderate Poisoning
- unable to walk
- weakness
- chest discomfort
- muscle twitches
- constriction of pupil of the eye
- earlier symptoms become more severe.

Severe Poisoning
- unconsciousness
- severe constriction of pupil of eye
- muscle twitches
- secretions from mouth and nose
- breathing difficulty
- death if not treated.

Illness may be delayed a few hours. But if signs or symptoms start more than 12 hours after you were exposed to the pesticide, you probably have some other illness. Check with your physician to be sure.

Carbamates—The only carbamates likely to make you ill on the job act almost like organophosphates. They produce the same signs and symptoms if you are poisoned by them. But the injury they cause can be corrected more easily by a physician. For this reason, most carbamates are safer than organophosphates. The label will warn you of the danger.

Organochlorines—Not many organochlorines (chlorinated hydrocarbons) have poisoned applicators.

Early signs and symptoms of poisoning include:

- headache,
- nausea,
- vomiting,
- general discomfort, and
- dizziness.

With more severe poisoning, convulsions follow. They may even appear without the warning symptoms. Coma may follow the convulsions. The person also may be unusually excited or irritable.

Nitrophenols and Pentachlorophenol—The signs and symptoms of skin exposure include:

- redness,
- burning, and
- blisters.

The signs and symptoms of poisoning include:

- headache,
- nausea,
- gastric distress,
- restlessness,
- hot feeling,
- flushed skin,
- sweating,
- deep and fast breathing,
- fast beating of the heart,
- fever,
- ashen color,
- collapse, and
- coma.

Severe poisoning usually runs a rapid course. One usually dies or is almost well within 24 to 48 hours.

Fumigants and Solvents—Too much exposure to these compounds may make a person seem drunk. The signs and symptoms are:

- poor coordination,
- slurring words,
- confusion, and
- sleepiness.

Repeated exposure to the fumigant methyl bromide has caused permanent internal injury without early signs or symptoms of poisoning. You can absorb a fatal dose of it before symptoms appear.

Inorganic Pesticides

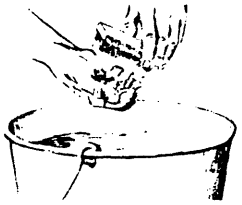
Large single doses of most inorganic pesticides cause vomiting and stomach pain. The signs and symptoms depend on the mineral from which the pesticide is made.

Plant-derived Pesticides

Some plant-derived pesticides are very toxic. Technical pyrethrum may cause allergic reactions. Some rotenone dusts irritate the respiratory tract. Nicotine is a fast-acting nerve poison about as dangerous as parathion. Some other plant-derived pesticides are strychnine, rotenone, and red squill.

First Aid Procedures

Read the directions in the "Statement of Practical Treatment" on each label. These instructions can save your life and the lives of your employees.



If you get a pesticide on your skin:

- Remove the pesticide as quickly as possible. Remove all contaminated clothing. Prompt washing may prevent sickness even when the spill is very large. Don't forget your hair and fingernails. Water-wettable powders or suspensions are easy to remove with plain water. So are most emulsifiable concentrates and emulsions. Solutions of pesticides in petroleum oil or other solvents are harder to remove without soap or a detergent. Detergents work better. Washrooms and emergency field washing facilities should have detergents rather than plain soap.

If you inhale a pesticide:

- Get to fresh air right away.

If you splash a pesticide into your mouth or swallow it:

- Rinse your mouth with plenty of water.
- Go or be taken to a physician immediately.
- It is sometimes dangerous to cause vomiting; follow label directions.

Protecting Your Body

Pesticides can enter the body in many ways. The main ones are:

- getting the pesticide on your skin,
- inhaling it, and
- swallowing it.

To prevent this, you must wear protective clothing and equipment. No safety recommendations can cover all situations. Your common sense should tell you to use more protection as the hazard increases. The pesticide label will tell you the kind of protection you need.

Remember to bathe, using a detergent, when you finish working with pesticides or pesticide-contaminated equipment. Any time you spill a pesticide on yourself, wash immediately.

Protective Clothing

Body Covering—Any time you handle pesticides, you should wear at least:

- a long-sleeved shirt and long-legged trousers, or
- a coverall type garment.

They should be made of closely woven fabric. When handling pesticide concentrates or very toxic materials, you also should wear a liquid-proof raincoat or apron. Wear trousers *outside* of the boots to keep pesticides from getting inside.

Gloves—When you handle concentrated or highly toxic pesticides, wear liquid-proof neoprene gloves. However, some fumigants are readily absorbed by neoprene. The label will tell you what kind of gloves to use. They should be long enough to protect the wrist. Gloves should not be lined with a fabric. The lining is hard to clean if a chemical gets on it. Sleeves should be *outside* of the gloves to keep pesticides from running down the sleeves and into the gloves.

Hat—Wear something to protect your head. A wide-brimmed, waterproof hat will protect your neck, eyes, mouth, and face. It should not have a cloth or leather sweatband. These sweatbands are hard to clean if chemicals get on them. Plastic "hard hats" with

plastic sweatbands are good. They are waterproof and are cool in hot weather.

Boots—Wear unlined neoprene boots. However, some fumigants are readily absorbed by neoprene boots. Follow label instructions.

Goggles or Face Shield—Wear goggles or a face shield when there is any chance of getting pesticides in your eyes. Your eyes will absorb many pesticides. You can wear goggles alone or with a respirator.

Care of Clothing—Wear clean clothing daily. If clothes get wet with spray, change them right away. If they get wet with pesticide concentrates or highly toxic pesticides, destroy them. They are hard to get clean by normal methods. Do not store or wash contaminated clothing with the family laundry. Wash hats, gloves, and boots daily, inside and out. Hang them to dry. Test gloves for leaks by filling them with water and gently squeezing.

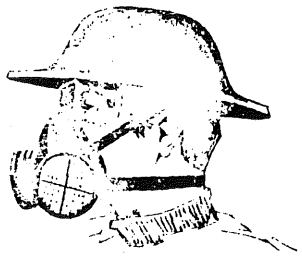
Wash goggles or face shields at least once a day. Elastic fabric headbands often absorb pesticides and are difficult to clean. Have some spares so you can replace them often, or use neoprene headbands.

Respiratory Protective Devices

The respiratory tract—the lungs and other parts of the breathing system—is much more absorbent than the skin. You *must* wear an approved respiratory device when the label directs you to do so. Follow the label instructions on respiratory protection.

You probably will need a respirator:

- if you will be exposed to a pesticide for a long time,
- if the pesticide you are using is highly toxic, or
- if you are working in an enclosed area.



Cartridge Respirator

Chemical Cartridge Respirator—You should wear this kind of respirator:

- when you are exposed to intermittent concentrations of a toxic pesticide.

The inhaled air comes through both a filter pad and a cartridge made to absorb pesticide vapors. Most harmful vapors, gases, and particles are removed. These half-face masks cover the mouth and nose. To cover the eyes also, use one that is combined with goggles or wear separate goggles.

Canister Respirator

Chemical Canister Respirator (Gas Mask)—You should wear this kind of respirator:

- when you are exposed to a continuous concentration of a toxic pesticide.

The canister has longer-lasting absorbing material and filters than a cartridge respirator. Gas masks usually protect the face better than cartridge types. Neither kind will protect you during fumigation or when the oxygen supply is low, as in a silo.

Supplied Air Respirator

Supplied Air Respirator—You may use this kind of respirator when mixing or applying pesticides:

- when the oxygen supply is low,
- when you are exposed to high concentrations of highly toxic pesticides in enclosed areas, as in fumigation, or
- when your work can be done close to a supply of clean air.

Clean air is pumped through a hose to the face mask.

Self-contained Breathing Apparatus

Self-Contained Breathing Apparatus—You should wear this kind of respirator under the same conditions as the supplied air respirator. It does about the same thing. The difference is that you carry cylinders of air or oxygen with you, usually on your back. This lets you move more freely and over a wider area then you can with a supplied air respirator.

Selection and Maintenance—Specific types of cartridges and canisters protect against specific chemical gases and vapors. Be sure you choose one made for the pesticides you are using. Use only those approved by the National Institute for Occupational Safety and Health (NIOSH), or the Mining Enforcement and Safety Administration (MESA).

The respirator must fit the face well. Long sideburns, a beard, or glasses may prevent a good seal. Read the manufacturer's instructions on the use and care of any respirator and its parts before you use it.

When applying pesticides, change filters, cartridges, and canisters if you have trouble breathing, or if you smell pesticides. Remove and discard filters, cartridges, and canisters after use. Then wash the face piece with detergent and water, rinse it, and dry it with a clean cloth. Store it in a clean, dry place away from pesticides.

The useful life of a cartridge or canister depends on:

- the amount of absorbent material,
- the concentration of contaminants in the air,
- the breathing rate of the wearer, and
- the temperature and humidity.

If you have trouble breathing while wearing a respiratory device, see your physician to find out whether you have a respiratory problem.

Protecting the Environment

The "environment" is our surroundings and its many forms of life. Every plant or animal is affected by other plants or animals in the environment. Factors like rain, temperature, and wind are part of the environment. We cannot do much about them. But we can control some other things, including the use of pesticides.

Many people consider pesticides a tool for preserving or improving the environment. Others feel that they cause pollution. As a weed is a "plant out of place," a pesticide sometimes can be a "tool out of place". Correct use prevents pollution by pesticides.

How Pesticides Harm the Environment

Using pesticides in a way other than as directed on the label can:

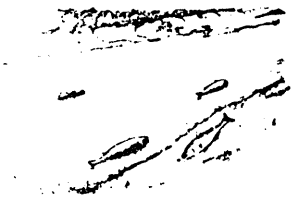
- injure plants and animals,
- leave illegal residues, and
- damage the environment in many other ways.

Any pesticide can cause harm if not chosen and used with care. Here are some ways damage can occur.

Direct Kill of Non-Target Organisms

Do not let a pesticide contact anything except the target area. Drift from herbicides can kill nearby crops and landscape plants. You may kill bees and other pollinators if you treat a crop while they are working in a field. Or you could kill parasites and predators that help control harmful insects.

Pesticides are sometimes applied over a large area. Targets are such things as mosquitoes, forest insects, and weeds. Many non-target plants and animals within the treated area may be harmed. Plan area projects with great care so you will not do irreparable damage to the environment.



Runoff from a sprayed field can kill fish in a nearby stream or pond. Life in streams can be wiped out by careless tank filling or draining and improper container disposal.

All of these kills can result in lawsuits, fines, and loss of certification.

If more than one pesticide will control your target pest, choose the one that is the least hazardous to the environment and most useful for your situation. Ask your Cooperative Extension agent to help you make this choice.

Persistence and Accumulation

Not all pesticides act the same after you apply them. Most are in one of these two groups:

Pesticides that break down quickly remain on the target or in the environment only a short time before being changed into harmless products. Some are highly toxic. Others are fairly harmless.

Pesticides that break down slowly may stay in the environment without change for a long time. Often this is good, because you get long term control. These are called *persistent pesticides*. Most of them:

- are not broken down easily by microorganisms, and
- are only slightly soluble in water.

Some persistent pesticides can injure sensitive crops planted on the same soil the next year. But they seem to be of little hazard to the environment beyond the treated soil. Other persistent pesticides can build up in the bodies of animals, including man. They may build up until they are harmful to the animal itself or to the meat eater that feeds on it. These are called *accumulative pesticides*.

Pesticide Movement in the Environment

Pesticides become problems when they move off target. This may mean:

- drifting out of the target area as mist or dust,
- moving on soil through runoff or erosion,
- leaching through the soil,
- being carried out as residues in crops and livestock, or
- evaporating and moving with air currents.

Soil and Pesticides

Persistent pesticides may limit future planting. You can plant only crops which the pesticide will not kill or contaminate.

Even pesticides directed at plants or animals can move to the soil. They may be washed or brushed off. They may be worked into the soil with dead plant parts.

Application Equipment

The pesticide application equipment you use is important to the success of your pest control job. You must first select the right kind of application equipment. Then you must use it correctly to suit your needs and take good care of it. These things are true whether you use hand-carried, tractor-drawn, self-propelled, or aircraft-mounted equipment. Here are some things you should know about choosing, using, and caring for equipment.

Sprayers

Your sprayer should be:

- designed to do the job you want to do,
- durable, and
- convenient to fill, operate, and clean.

Hand Sprayers

Hand sprayers are for professional application of pesticides in structures and can be used for small jobs around the home and garden. You can use them in restricted areas where a power unit would not work.

Advantages

- economical,
- simple, and
- easy to use, clean, and store.

Limitation

- frequent lack of good agitation and screening for wettable powders. Keep WP's in suspension by shaking the sprayer.

Low Pressure Field Sprayers

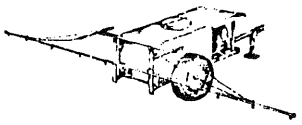
These sprayers are designed to deliver low to moderate volume at 15 to 50 psi. Most of them are used for treating field and forage crops, pastures, fence rows, and structures. They also may be used to apply fertilizer-pesticide mixtures.

Advantages

- medium to large tanks,
- low cost,
- light weight, and
- versatility.

Limitations

- low gallonage output limits their use when high volume is required,
- low pressure limits pesticide penetration, and
- agitation is limited.



High Pressure Sprayers

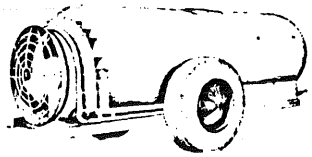
These are often called hydraulic sprayers. They are designed to deliver large volumes at high pressure. They are used to spray fruits, vegetables, trees, landscape plants, and livestock. When fitted with the correct pressure regulators, they can be used at low pressures. Applications usually are made at high gallonages (usually 100 or more per acre). Even though very large tanks are used, they may need to be filled often.

Advantages

- well built,
- usually have mechanical agitation, and
- last a long time even when using wettable powders.

Limitations

- high cost,
- large amounts of water, power, and fuel needed,
- high tire loads, and
- high pressure which makes a spray that drifts easily.



Air Blast Sprayers

These units use a high speed, fan-driven air stream to break the nozzle output into fine drops which move with the air stream to the target. The air is directed to either one or both sides as the sprayer moves forward. These sprayers are used in applying pesticides to landscape plants, fruits, and vegetables, and for biting fly control. Most air blast sprayers can be adapted to apply either high or low volumes of spray.

Advantages

- good coverage and penetration,
- low pump pressures, and
- mechanical agitation.

Limitations

- drift hazards,
- chance of overdosages,
- difficult to use in small areas, and
- hard to confine discharge to limited target areas.

Ultra Low Volume (ULV) Sprayers

Deliver undiluted pesticides from the air, on the ground, or in buildings.

Advantages

- no water is needed, and
- equal control with less pesticide.

Limitations

- does not provide for thorough wetting,
- hazards of using high concentrates,
- chance of overdosage, and
- small number of pesticides that can be used this way.

Sprayer Parts

Tanks

Tanks should have large openings for easy filling and cleaning. They should allow straining during filling and have mechanical or hydraulic agitation. The tank should be made of corrosion-resistant material such as stainless steel or glass reinforced plastic. If made of mild steel, it should have a protective plastic lining or coating. The tank should have a good drain. The outlets should be sized to the pump capacity. If you use dual tanks, make sure the plumbing allows for agitation and adequate withdrawal rates in both tanks. All tanks should have a gage to show the liquid level.

Flush out the tank, pump, lines, and nozzles after each day's use and each separate pesticide use. If switching to another pesticide where contamination must be prevented, wash out with detergent and water two or three times and then flush with water. Phenoxy herbicides such as 2,4-D are hard to remove. After using them, either follow the special cleaning procedures noted on the pesticide label or avoid using the same sprayer for any other product. Keep tank clean inside and out. Tighten or repair all leaky tank seals or fittings. Make sure sight gages can be read.

Pumps

The pump must be adequate for all the spraying pressures you use. It must provide enough flow to:

- supply all nozzles,
- allow for hydraulic agitation when needed, and
- leave a reserve to allow for loss of flow due to wear.

Pumps should resist corrosion and abrasion. Centrifugal pumps provide high volume at low pressure. They are not self-priming. Piston and diaphragm pumps provide moderate to high volumes at high pressure. They are self-priming. Roller and gear pumps provide moderate volume at low to moderate pressure. They are self-priming in most equipment. Do not use wettable powder formulations in gear pumps. If you need pressures above 75 psi, piston pumps are more likely to provide them over a long period of time.

You will damage a pump if you operate it dry or with a restricted inlet. Follow the manufacturer's recommendations for pump operation. Keep all shields in place.

Strainers (Filters)

Proper filtering of the pesticide:

- protects the working parts of the sprayer, and
- avoids time loss and misapplication due to clogged nozzle tips.

Filtering should be progressive, with the largest mesh screen in the suction line between the tank and the pump. Put a smaller mesh screen in the high pressure line between the pump and the pressure regulator. Put the finest mesh screen nearest the nozzles. Do not use a screen in the suction line of a centrifugal pump.

Clean strainers after each use. Replace them if you see deterioration. Strainers are your best defense against nozzle and pump wear and nozzle clogging. Use nozzle screens as large as nozzle sizes permit. Screen opening should be less than nozzle opening.

Hoses

Select synthetic rubber or plastic hoses that:

- have burst strength greater than the peak operating pressures,
- resist oil and solvents present in pesticides, and
- are weather-resistant.

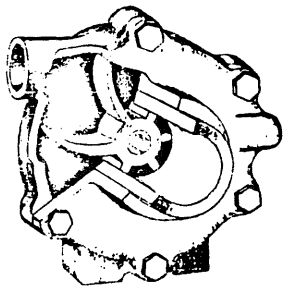
Suction hoses should resist collapse. They should be larger than pressure hoses. All fittings on suction lines should be as large as or larger than the line itself.

Keep hoses from kinking or being rubbed. Rinse them often, inside and outside, to prolong life. Remove and store hoses during off season, or at least store unit out of sun. Replace hoses at the first sign of surface deterioration.

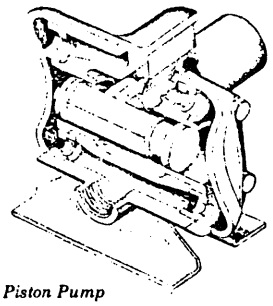
Pressure Gages

These serve as the monitor of your spraying job. They must be accurate and have only the range needed for your work. For example, a 0–60 psi gage with 2-pound gradations would be enough for most low pressure sprayers.

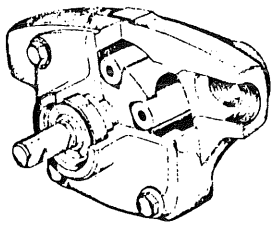
Check frequently for accuracy against an accurate gage. Do not use them under too much pressure. Keep glass faces clean and intact. Use gage protectors to protect against corrosive pesticides and pressure surges.



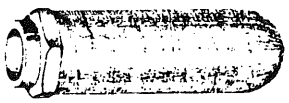
Centrifugal Pump



Piston Pump

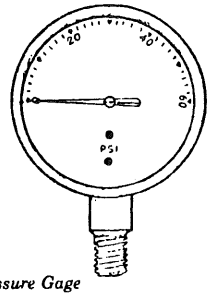


Roller Pump

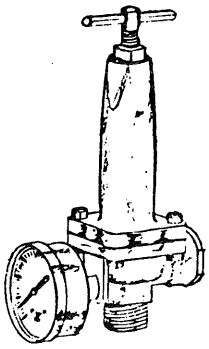


Strainer

Hose

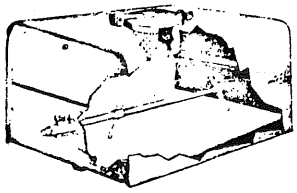


Pressure Gage



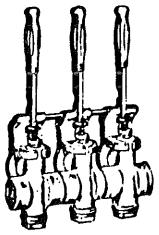
Pressure Regulators

The pressure regulator must have a working range that is about the same as the range of pressure you plan to use.



Agitators

Make sure your sprayer has enough agitation. If it does not, your pesticide application rate may vary greatly as the tank is emptied. Bypass agitation may be good enough for solutions and emulsions. Use a jet agitator or mechanical agitator for wettable powders. Mechanical agitation is the surest way to get good agitation. It is expensive initially and is harder to maintain. Hand sprayers must be shaken frequently.



Control Valves

These should be large enough so as not to restrict flow. They should be easy for you to reach. On-off action should be quick and positive. You need to be able to cut off all flow or flow to any section of the spraying system. There are many different kinds of control valves. Be sure you know how to operate and maintain the ones on your equipment.

Nozzles

The nozzle helps control the rate and pattern of distribution. These things depend on:

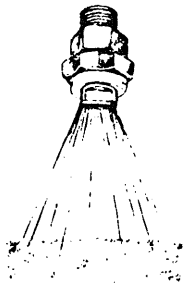
- the nozzle design or type,
- its operating pressure,
- the size of the opening,
- its discharge angle, and
- its distance from the target.

There are six basic nozzle types. They are:

Solid Stream—A type used in handguns to spray a distant target and for crack and crevice treatment in buildings. Also a type used in a nozzle body to apply pesticides in a narrow band or inject them into the soil.

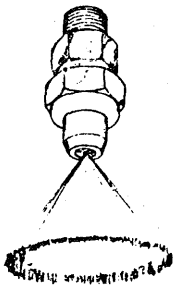
Flat Fan—There are three types of flat fan nozzles:

- The regular flat fan nozzle makes a narrow oval pattern with lighter edges. It is used for broadcast spraying. This pattern is designed to be used on a boom and to be overlapped 30–50 percent for even distribution.



- The even flat fan nozzle makes a uniform pattern across its width. It is used for band spraying and for treating walls and other surfaces.

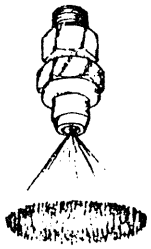
- The flooding nozzle makes a wide-angle flat spray pattern. It works at lower pressures than the other flat fan nozzles. Its pattern is fairly uniform across its width. It is used for broadcast spraying.



Hollow Cone—There are two types of hollow cone nozzles:

- the core and disk, and
- the whirl chamber.

The pattern is circular with tapered edges and little or no spray in the center. It is used for spraying foliage.



Solid Cone—This nozzle produces a circular pattern. The spray is well-distributed throughout the pattern. It is used for spraying foliage.

Atomizing Nozzle—Makes a fine mist from liquid pesticides. Used indoors in special situations.

Broadcast—This nozzle forms a wide flat fan pattern. It is used on boomless sprayers and to extend the effective swath width when attached to the end of a boom.

Many spraying jobs could be done by more than one nozzle type or pattern. Here are some general guidelines.

For weed control:
- regular flat fan,
- flooding fan,
- even flat fan,
- hollow cone.

For disease control:
- hollow cone,
- solid cone.

For insect control outdoors:
- regular flat fan,
- hollow cone,
- solid cone.

For insect control indoors:
- even flat fan,
- solid stream,
- atomizing.

To minimize drift:
- flooding fan,
- whirl chamber hollow cone,
- keep operating pressures below 30 psi.

You can get nozzles in many materials. Here are the main features of each kind.

Brass:
- inexpensive,
- wears quickly from abrasion,
- probably the best material for limited use.

Stainless steel:
- will not corrode,
- resists abrasion, especially if it is hardened.

Plastic:
- resists corrosion and abrasion,
- swells when exposed to some solvents.

Aluminum:
- resists some corrosive materials,
- is easily corroded by some fertilizers.

Tungsten carbide and ceramic:
- highly resistant to abrasion and corrosion,
- expensive.

Keep nozzles in good working condition. For most boom applications, select nozzles of uniform type and size.

Nozzle caps should not be overtightened. Adjust nozzle distance and spacing to suit the target. Follow the nozzle manufacturer's instructions and the pesticide label. Allow for crop or weed height if necessary. Check each nozzle for uniform flow using water and a jar marked in ounces. Replace any whose flow is 5 percent more or less than the average. Replace any nozzles having faulty spray patterns. A good check is to spray on asphalt pavement. Watch for streaks as you increase speed or as spray dries.

Clean nozzles only with a toothbrush or wooden toothpick.

Operation and Maintenance

Always read and follow the operator's manuals for all your spray equipment. They will tell you exactly how to use and care for it. After each use, rinse out the entire system. Remove and clean nozzles, nozzle screens, and strainers. Check for leaks in lines, valves, seals, and tank both after filling with water and during running.

Be alert for nozzle clogging and changes in nozzle patterns. If nozzles clog or other trouble occurs in the field, be careful not to contaminate yourself while correcting the problem. Shut off the sprayer and move it to the edge of the field before dismounting. Wear protective clothing while making repairs.

Store sprayers correctly after use. But first, rinse and clean the system. Then fill tank almost full with clean water. Add a small amount of new light oil to the tank. Coat the system by pumping tank contents out through nozzles or handgun. Drain the pump and plug its openings or fill the pump with light oil or antifreeze. Remove nozzles and nozzle screens and store in light oil or diesel fuel.

Dusters and Granular Applicators

Hand Dusters

Like hand sprayers, hand dusters are for professional use in structures and can be used in gardens. They

may consist of a squeeze bulb, bellows, tube, or shaker, a sliding tube, or a fan powered by a hand crank.

Advantages

- the pesticide is ready to apply, and
- good penetration in confined spaces.

Limitations

- high cost for pesticide,
- hard to get good foliar coverage, and
- dust is subject to drifting.

Power Dusters

Power dusters use a powered fan or blower to propel the dust to the target. They range from knapsack or backpack types to those mounted on or pulled by tractors. Their capacity in area treated per hour compares favorably with some sprayers.

Advantages

- simply built,
- easy to maintain, and
- low in cost.

Limitations

- drift hazards,
- high cost of pesticide, and
- application may be less uniform than with sprays.

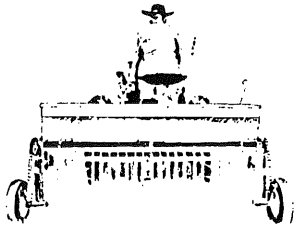
Selecting a Duster

Look for a power duster that is easy to clean. It should give a uniform application rate as the hopper is emptied. Look for both hand and power dusters that keep the dust cloud well away from the user.

Granular Applicators

These include:

- hand-carried knapsack and spinning disk types for broadcast coverage,
- mounted equipment for applying bands over the row in row crops, and
- mounted or tractor-drawn machines for broadcast coverage.



Advantages

- eliminates mixing,
- is low in cost,
- minimizes drift, and
- is less hazardous to applicator.

Limitations

- high cost for pesticide,
- limited use against some pests because granules won't stick to most plants,
- need to calibrate for each granular formulation, and
- poor lateral distribution, especially on side slopes.

Selecting a Granular Applicator

Choose a granular applicator that is easy to clean and fill. It should have mechanical agitation over the outlet holes. This will prevent bridging and keep flow rate constant. Application should stop when drive stops even if outlets are still open.

Use and Maintenance

Both dusters and granular applicators are speed-sensitive, so maintain uniform speed. Do not travel too fast for ground conditions. Bouncing equipment will cause the application rate to vary. Stay out of any dust cloud that may form.

Watch banders to see that band width stays the same. Small height changes due to changing soil conditions may cause rapid changes in band width.

Clean equipment as directed by the operator's manual.

Fumigant Applicators

This equipment is of two types:

- that needed to handle low pressure fumigants, and
- that needed to handle high pressure fumigants which are kept liquid only by storage in pressure vessels.

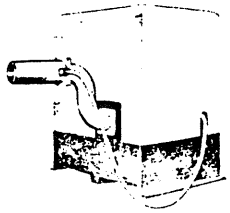
The low pressure fumigators are gravity or pump fed units. Most high pressure units use the pressure generated by the fumigant or a compressed gas to force the fumigant into the soil or space being fumigated.

Selection

Choosing equipment to apply low pressure fumigants is similar to choosing a low pressure sprayer. But corrosion-resistant pumps, tanks, fittings, nozzles, and lines are essential. High pressure fumigators must be able to withstand the internal pressure created by the fumigant. Select equipment with pressure or flow regulators that assure constant delivery rates.

Use and Maintenance

Keep the units in good repair. Make sure there are no leaks. Replace hoses and fittings as soon as you see signs of deterioration. Lines and fittings should not be located near the operator. Empty all lines after application. To avoid contamination and corrosion, flush the units after use. Carefully follow all precautions on the fumigant label.



Aerosol Generators and Foggers

Aerosol generators work by using:

- atomizing nozzles,
- spinning disks, and
- small nozzles at high pressure.

Fogs are usually generated by thermal generators using heated surfaces.

Advantages

- efficient distribution of liquid pesticides in enclosed spaces,
- efficient distribution of liquid pesticides in dense foliage, and
- some devices automatic in operation.

Limitations

- aerosols and fogs extremely sensitive to drift, and
- repeated application needed to maintain effectiveness.

Selection

Choose an aerosol generator according to where you will use it—indoors or outdoors. Aerosol and fog generators are manufactured for many special uses. Truck- and trailer-mounted machines are for use outdoors. Most hand-operated or permanently mounted automatic machines are for use indoors.

Use and Maintenance

In general, use and care for an aerosol generator as you would a sprayer. They do require special precautions. Be sure that the pesticides used in them are registered for such use. Keep them on the target. Because of the effects of weather conditions during application, follow special use instructions. The operator, other humans, and animals must be kept out of the fog or smoke cloud.

Calibration

Calibration is simply adjusting your equipment to apply the desired rate of pesticide. You need to do this so that you can be sure you are using each pesticide as directed on the label. Too much pesticide is dangerous; too little will not do a good job. Only by calibrating correctly can you safely get the best results.

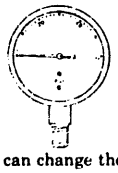
There are many ways to calibrate equipment. The preferred methods differ according to the kind of equipment you use. Your Cooperative Extension Service personnel can show you how to calibrate your equipment. Here is one basic method for sprayers and another for dusters and granular applicators.

Sprayers

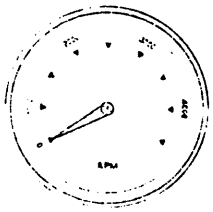
To apply a pesticide evenly and accurately, your sprayer must move at a constant speed. It also must operate at a constant pressure. Each nozzle must be clean and at the right height. All nozzles must be of the correct type and size for the job. Each nozzle in the system must deliver its rated amount of pesticide.

First, choose the speed, pumping pressure, and nozzle or nozzles that you want to use. Fill the spray tank with water and operate the sprayer in place to fill the plumbing. Top off the tank and spray a measured area as if you were applying the pesticide. Measure the amount of water needed to refill your tank. This is the application rate per unit of area. If it takes 8 gallons to refill the tank after spraying one acre, you are spraying at the rate of 8 gallons per acre. If your sprayer has a tank of more than 100 gallons capacity, you should spray an area large enough to use at least 10 percent of the tank capacity.

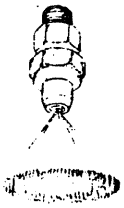
If your sprayer is delivering more or less spray than the label directs, you can change the rate three ways:



- You can change the pressure. Lower pressure means less spray delivered; higher pressure means more spray delivered. This is not a good method, because a pressure change may change the nozzle pattern and droplet size. Pressure must be increased 4 times to double the output.



- You can change the speed of your sprayer. Slower speed means more spray delivered, faster speed means less spray delivered. This method is practical for small changes in delivery rate. If you drive half as fast, you double the delivery rate.



- You can change the nozzle tips to change the amount delivered. The larger the hole in the tip, the more spray delivered. This is the best method for making major changes in the delivery rate

of sprayers. Always select nozzles for the job you want done. Use the manufacturer's performance charts to make your selection.

After making a change, you must recalibrate your sprayer to make sure the rate is correct.

You have adjusted your sprayer and you know how many gallons of spray per unit of area your equipment will apply. Next you must find out how much pesticide to put in the tank to apply the correct dosage of pesticide. To do this you need to know two more facts:

- How much your sprayer tank holds.
- The amount of formulation to be used per unit of area. This will be given on the label.

Suppose your tank holds 50 gallons of spray. The directions say to apply one pint of formulation on each acre. In our example, you found that your sprayer applies 8 gallons per acre. First find the number of acres one tank load will spray. Divide 50 gallons by 8.

$$\frac{\text{50 gallons per tankful}}{\text{8 gallons per acre}} = 6\tfrac{1}{4} \text{ acres per tankful}$$

To find the amount of formulation you must add to your tank so you can spray $6\frac{1}{4}$ acres with one pint per acre, multiply 1 pint by $6\frac{1}{4}$.

1 pint per acre × $6\frac{1}{4}$ acres per tankful = $6\frac{1}{4}$ pints per tankful.

Suppose the formulation of a pesticide is a 50 percent wettable powder and you want to apply $\frac{1}{2}$ pound of active ingredient per acre. In our example your tank will cover $6\frac{1}{4}$ acres.

Add the proper amount of pesticide

Find how many pounds of formulation are needed to apply $\frac{1}{2}$ pound of active ingredient per acre. There is $\frac{1}{2}$ pound of active ingredient in 1 pound of 50 percent wettable powder formulation. So you need to use 1 pound of formulation for each acre your sprayer will cover.

1 pound per acre × $6\frac{1}{4}$ acres per tankful = $6\frac{1}{4}$ pounds per tankful.

You should add the $6\frac{1}{4}$ pounds of wettable powder to a small amount of water in a clean bucket. Stir until it is mixed well and then add this mixture (called a slurry) to the partly filled tank. Remember to operate the sprayer's agitator while adding the slurry and filling the tank.

Make a slurry

Even after your sprayer is calibrated, you should recheck it often. Be sure you are spraying the same size area for each tankful as you figured on. If you are spraying more or less acres than you planned, stop spraying and recalibrate. If you have figured wrong or your sprayer changes its delivery rate, you will be able to catch it before you make a major mistake.

Dusters and Granular Applicators

- Read the manufacturer's operator's manual. Follow these instructions to set the gate openings for the product you are going to use. **Caution:** always set the openings from the same direction, such as from closed to open. This will minimize variations in settings.
- Fill each hopper to an easily determined level.
- Operate the equipment over a measured area or distance at your normal working speed. The area should be large enough to use $\frac{1}{4}$ of the hopper contents.
- Refill the hopper to the same level, weighing the amount of pesticide needed to replace what was used.
- The amount of pesticide it takes to refill the hopper is the amount applied to the measured area. If the amount applied does not fall within 5 percent of the recommended dosage per unit of area, reset the gate opening and repeat the previous three steps.
- Keep a record of the area treated with each filling of the hopper. This will let you see any slight change in rate of application and make the necessary adjustments.

MINNESOTA PESTICIDE CONTROL LAW OF 1976

Sections 18A.21 - 18A.45

State of Minnesota
Department of Agriculture
Division of Agronomy Services
St. Paul, Minnesota

Section 18A.21 DEFINITIONS. Subdivision 1. For the purpose of administering sections 18A.21 to 18A.45, the words and terms defined in this section have the meanings given them.

Subd. 2. "Active ingredient" means any ingredient which will prevent, destroy, repel, control, or mitigate any pests, or which acts as a plant regulator, defoliant, or desiccant.

Subd. 3. "Administrator" means the administrator of the United States environmental protection agency.

Subd. 4. "Adulterated" means any pesticide the strength or purity of which falls below the standard of quality as expressed on the labeling under which it is sold, any pesticide for which any substance has been substituted wholly or in part, or any pesticide from which any valuable constituent has been wholly or in part abstracted.

Subd. 5. "Approved agency" means an agency of a county, municipality or other political subdivision which has inspection personnel capable of carrying out the provisions of sections 18A.21 to 18A.45 and which has signed an agreement pursuant to Minnesota Statutes, Section 471.59.

Subd. 6. "Beneficial insects" means those insects which during their life cycle, are effective pollinators of plants, are parasites or predators of pests, or are otherwise beneficial.

Subd. 7. "Certified applicator" means an individual, including persons defined as commercial applicator, noncommercial applicator, private applicator, and structural pest control applicator, certified under sections 18A.21 to 18A.45 to use or supervise the use of any restricted use pesticide.

Subd. 8. "Commercial applicator" means a certified applicator other than a private applicator or noncommercial applicator who uses or supervises the use of any pesticide for any purpose or on any land.

Subd. 9. "Commissioner" means the commissioner of agriculture or his agent.

Subd. 10. "Device" includes any instrument, contrivance, or equipment other than a firearm, used for the application of pesticides when sold separately therefrom, intended for trapping, destroying or repelling pests.

Subd. 11. "Distribute" means to offer for sale, sell, barter, ship, deliver for shipment, receive and deliver, and offer to deliver pesticides in this state.

Subd. 12. "Environment" includes water, air, land, plants, man, and animals and their inter-relationships.

Subd. 13. "EPA" means the United States environmental protection agency.

Subd. 14. "FIFRA" means the federal insecticide, fungicide, rodenticide act, as amended.

Subd. 15. "Imminent hazard" means the continued use of a pesticide, during the time required for cancellation proceedings, which will likely result in unreasonable adverse effects on the environment or will

involve unreasonable hazard to the survival of a species declared endangered by the United States secretary of the interior under P.L. 91-135.

Subd. 16. "Ingredient statement" means a statement which contains the name and percentage of each active ingredient, the total percentage of all inert ingredients in the pesticide and, if the pesticide contains arsenic in any form, the percentages of total and water soluble arsenic each calculated as elemental arsenic.

Subd. 17. "Label" means the written, printed or graphic matter on, or attached to, the pesticide or device or any of their containers or wrappers.

Subd. 18. "Labeling" means all labels and other written, printed, or graphic matter:

(a) upon any pesticide or device or any of their containers or wrappers;

(b) accompanying the pesticide or device;

(c) to which reference is made on the label or literature accompanying the pesticide or device; or

(d) which relates or refers to the pesticide or device for the purpose of inducing the sale thereof.

Current official publications of the EPA, United States department of agriculture, United States department of interior, United States department of health, education and welfare, state agricultural experiment stations, state agricultural colleges, and other similar federal or state institutions or agencies authorized by law to conduct research in the field of pesticides are not labeling.

Subd. 19. "Land" means all land and water areas including air space and all plants, animals, structures, buildings, contrivances and machinery whether fixed or mobile, including anything used for transportation.

Subd. 20. "Licensed pesticide dealer" means any pesticide dealer licensed by the commissioner who sells to the ultimate consumer or any person licensed by the commissioner purchasing from an unlicensed source for his own use any restricted use pesticide.

Subd. 21. "Misbranded" applies to any pesticide or device that is an imitation of or is offered for sale under the name of another pesticide or a pesticide the labeling of which does not comply with the labeling requirements of sections 18A.21 to 18A.45 or rules promulgated thereunder, or the FIFRA and regulations promulgated thereunder.

Subd. 22. "Noncommercial applicator" means a person, including government officials, other than a commercial applicator, structural pest control applicator or private applicator who uses or supervises the use of restricted use pesticides on lands.

Subd. 23. "Person" means any individual, firm, corporation, partnership, association, trust, joint stock company or unincorporated organizations.

Subd. 24. "Pest" means any insect, rodent, nematode, fungus, weed, terrestrial or aquatic plant, animal life, virus, bacteria, or other orga-

nism which the commissioner by rule declares to be a pest except virus, bacteria, or other micro-organism on or in living man or other living animals.

Subd. 25. "Pesticide" means any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

Subd. 26. "Plant regulator" means any substance or mixture of substances intended through physiological action to accelerate or retard the rate of growth or rate of maturation of a plant, or to otherwise alter the behavior of ornamental or crop plants or the produce thereof, but shall not include substances to the extent that they are intended as plant nutrients, trace elements. nutritional chemicals, plant inoculants, or soil amendments.

Subd. 27. "Private applicator" means a person who uses or supervises the use of any restricted use pesticide for the purpose of producing any agricultural commodity on land owned or rented by him or his employer or, if applied without compensation other than trading of personal services between producers of agricultural commodities, on the land of another person.

Subd. 28. "Protect the environment" means to protect against any unreasonable adverse effects on the environment other than on pests.

Subd. 29. "Registrant" means a person who has registered any pesticide under sections 18A.21 to 18A.45.

Subd. 30. "Restricted use pesticide" means any pesticide formulation designated under FIFRA or by the commissioner under sections 18A.21 to 18A.45 which when used in accordance with the directions for use and for the uses for which it is registered requires additional restrictions as to the rates, areas, times and conditions of use to protect the environment.

Subd. 31. "Spraying or dusting operations for hire" means the application for compensation of pesticides or plant growth regulators to land in any manner to regulate plant growth or to control or eradicate pests.

Subd. 32. "Structural pest" means pests in, on, under, or within six feet of any structure.

Subd. 33. "Structural pest control" means to control any pest through the use of any device, procedure, or application of pesticide in any house or in other structures including trucks, boxcars, ships, aircraft, docks, warehouses, and in fumigation vaults, and all business activity related to use of the device, procedure, or application of pesticide.

Subd. 34. "Structural pest control applicator" means any person engaged in structural pest control work for hire on the lands of another.

Subd. 35. "Under the direct supervision of a certified applicator" means, unless otherwise prescribed by its labeling, a pesticide applied by a person acting under the instruction and control of a certified applicator who is available even though such certified applicator is not physically present at the time and place the pesticide is applied.

Subd. 36. "Unreasonable adverse effects on the environment" means any unreasonable risk to the environment, considering the economic, social and environmental costs and benefits of the use of any pesticide.

Subd. 37. "Wildlife" means all living things that are neither human, domesticated, nor pests.

Section 18A.22 REGISTRATION, SALES, FEE. Subdivision 1. Every pesticide offered for sale, sold or distributed in this state shall be registered with the commissioner. Registration shall be renewed annually prior to January 1. Registration is not required if a pesticide is shipped from one plant or warehouse to another plant or warehouse operated by the same person and used solely at the plant or warehouse as a constituent part to make a pesticide which is registered under the provisions of sections 18A.21 to 18A.45.

Subd. 2. The applicant for registration shall file with the commissioner a statement which shall include:

(a) The name and address of the applicant and the name and address of the person whose name will appear on the label, if other than the applicant;

(b) The name of the pesticide;

(c) Other necessary information required by the registration form;

(d) A complete copy of the labeling accompanying the pesticide and a statement of all claims to be made for it, including the directions for use and the use classification as provided for in FIFRA.

Subd. 3. The commisioner may require the submission of the complete formula of any pesticide including the active and inert ingredients.

Subd. 4. The commisioner may require the submission of other relevant information.

Subd. 5. Each application for registration and renewal shall be accompanied by a registration fee of $10 for each pesticide registered. All such registrations shall expire on December 31 of any one year, unless cancelled.

Subd. 6. Any registration in effect on December 31 for which a renewal application has been made and the proper fee paid, shall continue in full force and effect until such time as the commissioner notifies the applicant that the registration has been renewed or until the registration is denied or cancelled.

Subd. 7. If the renewal of a pesticide registration is filed after December 31, or an original application is filed after the first month the pesticide is first manufactured or sold within this state, an additional fee of $5 shall be paid by the applicant before the registration for that pesticide may be issued or renewed.

Subd. 8. The commissioner shall not make lack of essentiality a criterion for denying registration of any pesticide.

Section 18A.23 SPECIAL LOCAL NEEDS. If the state is certified by the administrator to register pesticides to meet special local

needs, the applicant shall supply the information required by section 18A.22 and the commissioner shall, subject to the terms and conditions of certification, register such pesticide if he determines that:

(a) Its composition is such as to warrant the proposed claims for it;

(b) Its label and other material required to be submitted comply with the requirements of sections 18A.21 to 18A.45;

(c) It will perform its intended function without unreasonable adverse effect on the environment;

(d) When used in accordance with widespread and commonly recognized practice it will not generally cause unreasonable adverse effects on the environment;

(e) The proposed classification for general use or restricted use, or both, is in conformity with FIFRA; and

(f) A special local need exists.

The commissioner may require a full description of tests and test results upon which claims are based for any pesticide not registered pursuant to section 3 of FIFRA, or for any pesticide on which restrictions are being considered.

The commissioner may require other relevant information. The applicant may request confidentiality of information submitted pursuant to section 18A.35 of this act.

Section 18A.24 EXPERIMENTAL USE PERMITS. If the state is authorized by the administrator to issue experimental use permits, the commissioner may:

(a) Issue an experimental use permit if he determines that the applicant needs the permit in order to accumulate information necessary to register a pesticide under section 18A.22. An application for an experimental use permit may be filed at any time;

(b) Refuse to issue an experimental use permit if he determines that issuance of such permit is not warranted or that the use to be made of the pesticide under the proposed terms and conditions may cause unreasonable adverse effects on the environment;

(c) Prescribe terms, conditions, and period of time for the experimental use permit; and

(d) Revoke or modify an experimental use permit at any time if he finds that its terms or conditions are being violated, or that its terms and conditions are inadequate to avoid unreasonable adverse effects on the environment.

Section 18A.25 CERTIFICATION REQUIREMENTS; PROHIBITION. No person shall use or supervise the use of any restricted use pesticide without first complying with the certification requirements of sections 18A.21 to 18A.45, and with any other conditions determined by the commissioner to be necessary to prevent unreasonable adverse effects on the environment. A person who is not a certified applicator may use a restricted use pesticide only under the direct supervision of a certified applicator.

Section 18A.26 LICENSE, REGISTRATION, DEALER, APPLICATOR, FEE. Subdivision 1. RESTRICTED USE PESTICIDE DEALER LICENSE. (a) Any person offering for sale or having in his possession with intent to distribute to the ultimate user a restricted use pesticide and any private applicator purchasing from an unlicensed source for his own use any restricted use pesticide shall obtain a license from the commissioner. Application for a restricted use pesticide dealer license shall be made upon the forms and in the manner, which may include an examination, as the commissioner requires to determine if the applicant is qualified to sell restricted use pesticides.

(b) Application for a license requires payment of a fee of $35. Licenses shall be renewed annually prior to January 1, upon receipt of a $35 fee and the completed application form.

(c) If an application for renewal of a restricted use pesticide dealer license is not filed prior to January 1 of any one year, an additional fee of $10 shall be paid by the applicant before the renewal license may be issued.

(d) The dealer license shall not be transferable to another person or to another location.

(e) Each licensed restricted use pesticide dealer shall be responsible for the acts of each person employed by him in the solicitation and sale of restricted use pesticides.

(f) Provisions of this subdivision shall not apply to:

(1) A licensed commercial applicator, noncommercial applicator or structural pest control applicator who sells or uses pesticides only as an integral part of his pesticide application service;

(2) A federal, state, county, or municipal agency which provides pesticides only for its own programs; and

(3) A duly licensed pharmacist, physician, dentist, or veterinarian when administering or dispensing a restricted use pesticide for use in man or other animal in his practice.

Subd. 2. COMMERCIAL APPLICATOR LICENSE. (a) No commercial applicator shall use or supervise the use of any pesticide without a commercial applicator's license issued by the commissioner. Application for the license shall be made upon forms and in such manner, which may include an examination, as the commissioner may require. An aerial applicator shall secure an endorsement to his license showing that he has been licensed for commercial spraying or dusting operations, or both, in accordance with Minnesota Statutes, Chapter 360, and that he has passed an examination prepared by the department of aeronautics and administered by the department of agriculture, testing whether he is knowledgeable in the aerial application of pesticides. A person intending to apply pesticides in any public waters shall secure an endorsement to his license showing that he has passed an examination prepared by the department of natural resources and administered by the department of agriculture, testing whether he is knowledgeable in the application of pesticides in water.

(b) The commissioner may renew any applicator's license, subject to reexamination or other requirements imposed by the commissioner to

ensure the applicator understands changing technology and to assure a continuing level of competence and ability to use pesticides safely and properly.

(c) Each application for a license shall require payment of an annual fee of $10 and an identification card fee of $7.50 for the applicant and $7.50 for each additional identification card desired.

(d) If the renewal application is not filed prior to March 1 in any year, an additional fee of $5 shall be paid by the applicant before the renewal license may be issued.

(e) The license issued shall not be transferable to another person.

(f) Every licensee or his designated operator shall have an identification card when applying pesticides for hire and shall display it upon demand of an authorized representative of the commissioner or a law enforcement officer. The identification card shall contain such information as the commissioner may by rule require.

(g) A person required to be licensed under this subdivision who carries on spraying or dusting operations for hire or who employs or engages an applicator to carry on spraying or dusting operations for hire, shall be responsible for proper application of the material or device. He shall use materials, dosages, formulas, devices and methods of application acceptable to the commissioner based upon registered approved uses of the material or device within limits prescribed by state and federal laws and regulations. He shall not be held liable for the actions of a chemical when applied in accordance with the recommendation of the manufacturer or the commissioner.

Subd. 3. STRUCTURAL PEST CONTROL APPLICATOR LICENSE, REGISTRATION. (a) No person shall engage in structural pest control applications for hire unless registered or licensed by the commissioner. Before any person shall engage in structural pest control application he shall apply on forms supplied by the commissioner for a registration or license to engage in such activities. The commissioner shall determine from the application and the statements contained therein if such applicant is qualified to be registered or to receive a license. The commissioner shall require the applicant to pass a written or an oral examination, or both, and may also require a practical demonstration regarding structural pest control. The examination procedure, including all the phases and contents of the examination, shall be established by the commissioner.

(b) A registration or license is effective until January 1 next following the date of its issuance, and may be renewed annually on or before that date. Registrations or licenses are not transferable to any other person.

(c) An annual fee of $15 must accompany an application for registration or renewal where the applicant is licensed by a political subdivision or municipality to engage in structural pest control or $75 if the applicant is not so licensed. Employees of a person who is registered or licensed under the subdivision shall pay a fee of $10 for an initial license or registration and a fee of $6 for each renewal thereof. The commissioner may establish other requirements for renewal as are necessary to assure competence of registrants or licensees.

(d) In a case a delinquency in the payment of the license or registration renewal fee extends beyond three months the licensee or registrant will be required to obtain a new license or registration subject to all the requirements, procedures and fees required for an initial license or registration.

(e) The commissioner shall establish categories of master, journeyman, and apprentice in structural pest control applications. No person shall engage in structural pest control applications as a sole proprietorship, company, partnership, or corporation unless he is licensed or registered as a master in structural pest control applications or unless he employs a person so licensed or registered.

(f) The commissioner shall notify each licensee or registrant by mail that his fee is due and payable and if not received before the expiration date of the registration or license 50 percent will be added to the required annual renewal fee or fees.

Subd. 4. NONCOMMERCIAL APPLICATOR. (a) No noncommercial applicator may use a restricted use pesticide or supervise the use of a restricted use pesticide without having a valid noncommercial applicator license issued by the commissioner for use categories or subcategories for which the pesticide application is made.

(b) License applications shall be made upon forms and in the manner, which may include an examination, as the commissioner may prescribe to determine if the applicant is qualified.

(c) The commissioner may renew a license subject to reexamination or other requirements designed to ensure that the applicator continues to understand changing technology and to assure a continuing level of competence and ability to use pesticides safely and properly.

(d) Each application for a license shall require payment of an annual fee of $10 and an identification card fee of $7.50 for the applicant and $7.50 for each additional identification card desired. Governmental agencies shall be exempt from the fee. The license shall be renewed annually prior to January upon payment of applicable fees and compliance with any other requirement.

(e) If an application for renewal of license is not filed prior to March 1, in any year, an additional fee of $5 shall be paid by the applicant before the renewal license may be issued.

Sec. 18A.27 CLASSIFICATION OF LICENSES; STANDARDS. The commissioner may classify or subclassify certifications or licenses as necessary for the administration and enforcement of sections 18A.21 to 18A.45. Such classifications may include, but not be limited to, pest control operators, ornamental, agricultural, or right-of-way pesticide applicators. Separate subclassifications may be specified as to ground, aerial, or manual methods to apply pesticides or to the use of pesticides to control insects, plant diseases, rodents, or weeds. Each classification shall be subject to separate testing procedures and requirements. No person shall be required to pay a fee for any classification or subclassification certificate or license if he has paid the fee for the license under which the particular classification or subclassification is placed.

Sec. 18A.28 RECORDS, REPORTS. Subdivision 1. LICENSED RESTRICTED USE PESTICIDE DEALER. In addition to other requirements, all persons licensed to sell restricted use pesticides shall maintain records as required by the commissioner. Records shall be submitted periodically and at least once annually but in no case later than 30 days following the end of the license year. Records shall be upon forms supplied by the commissioner. All records required under this section shall be kept and made available for inspection upon request by the commissioner, his agents, or officials of an approved agency for a period of two years from the date of sale.

Subd. 2. LICENSED COMMERCIAL APPLICATOR. Each licensed commercial applicator, or his authorized agent, shall keep and maintain a record of land treated. Such a record shall include, but not be limited to, the following: date of treatment; material and dosage used; number of units treated; name and address of customer; name of applicator; and signature of operator. Invoices containing the required information may constitute the required record. A copy of his record shall be given to a consumer. Records shall be kept and be available upon request of the commissioner or his agents or officials of an approved agency for a period of two years from the date of treatment.

Subd. 3. LICENSED OR REGISTERED STRUCTURAL PEST CONTROL APPLICATOR. Each registered or licensed person engaged in structural pest control applications shall maintain records of all structural pest control applications conducted by him or by his employees. The records shall include but not be limited to: the date of treatment; name of chemical used; temperature and exposure time if fumigating; method of application; name and address of customer; and any other information as may be required by the commissioner. Records shall be retained for two years.

Subd. 4. INSPECTION OF RECORDS. The commissioner shall have access to the records required to be kept by this section at any reasonable time and to make copies of the records. Unless required for the enforcement of sections 18A.21 to 18A.45, such information shall be confidential and if summarized shall not identify an individual person.

Subd. 5. REPORTS. Licensed commercial applicators, licensed or registered structural pest control applicators, and licensed noncommercial applicators shall report to the commissioner the use of all restricted use pesticides at least once annually but in no case later than 30 days following the end of the licensed year. Such reports shall be upon forms provided by the commissioner.

Subd. 6. EPA. The commissioner is authorized to make reports to the EPA as it may require.

Sec. 18A.29. PRIVATE APPLICATORS. Subdivision 1. No private applicator shall use or supervise the use of any restricted use pesticide without first complying with the certification requirements determined by the commissioner as necessary to prevent unreasonable adverse effects on the environment by the proposed restricted pesticide.

Subd. 2. A private applicator shall be deemed competent to use restricted use pesticides when he attests that he: has read and understands the label; will use the pesticide according to the label directions; and is competent to use the pesticide properly.

Subd. 3. The commissioner may through cooperation with various government agencies provide training to ensure that certified private applicators continue to understand changing technology and to ensure a continuing level of competency and ability to use pesticides properly and safely.

Sec. 18A.30. CLAIM OF DAMAGE; INSPECTION; REPORT. Subdivision 1. A person claiming damage from the application of a pesticide may file with the commissioner a written statement containing his name and address, the name of the person for whom the application was done, the name of the applicator, the date of the application, the date of the damage, a description of the damage, a request that the commissioner inspect the damage, and such other information as the commissioner may require.

Subd. 2. If the statement is filed within 30 days after the pesticide was applied or the damage occurred, or, if the alleged damage is to agricultural crops, prior to the time that 25 percent of the damaged crops have been harvested, whichever is the latest, the commissioner shall inspect the damage to see whether any provisions of sections 18A.21 to 18A.45 have been violated.

Subd. 3. The commissioner shall make a report of his findings and take such further action as he deems necessary. A copy of the report shall be available to any claimant or applicator, or their agents, upon written request.

Sec. 18A.31. STORAGE, HANDLING, DISPOSAL OF PESTICIDES AND CONTAINERS. Subdivision 1. No person shall store any pesticide or pesticide container in a manner which is likely to endanger humans, damage agricultural products, damage food and livestock, damage wildlife, damage beneficial insects or pollute the environment.

Subd. 2. All pesticides and their containers shall be disposed of in accordance with law except when returned to the original manufacturer or distributor, or their agents for resale, reformulation, or disposal.

Sec. 18A.32. INSPECTION, ENFORCEMENT, JUDICIAL ACTION. Subdivision 1. INSPECTION. (a) The commissioner, and his agents, shall have access at reasonable times to all places where a person manufactures, formulates, distributes, uses, disposes of, stores or transports any pesticide or device and to all places affected by the use of any pesticide or device. The purposes for which entry to such places may be made shall include, but are not limited to:

(1) Inspect any equipment for the manufacture, formulation, distribution, disposal or application of pesticides and the premises on which such equipment is stored;

(2) Inspect or sample lands actually or reported to be exposed to pesticides;

(3) Inspect storage or disposal areas;

(4) Inspect or investigate complaints of injury to humans, wildlife, domesticated animals, or land;

(5) Sample pesticides being applied or to be applied; or

(6) Observe the use and application of a pesticide.

(b) Prior to leaving the premises inspected the commissioner shall give the owner, operator, or agent in charge, a receipt describing any samples obtained. If an analysis is made of the samples, a copy of the results of such analysis shall be furnished to the owner, operator, or agent in charge.

Subd. 2. ENFORCEMENTS. (a) When the commissioner has reasonable cause to believe a pesticide or device is being distributed, stored, transported or used in violation of sections 18A.21 to 18A.45 or of any rules thereunder, he may issue and serve a written stop sale, use, or removal order upon the owner or custodian of any such pesticide or device. If the owner or custodian is not available for service of the order, the commissioner may attach the order to the pesticide or device and notify the owner or custodian and the registrant. The pesticide or device shall not be sold, used, or removed until the violation has been corrected and the pesticide or device has been released in writing under conditions specified by the commissioner, or until the violation has been otherwise disposed of by a court.

(b) If the commissioner is denied access to any land, he may apply to a court of competent jurisdiction for a search warrant authorizing access to the land. The court may, upon such application, issue the search warrant for the purpose requested upon a showing that probable cause exists that a violation of sections 18A.21 to 18A.45 is occurring or has occurred upon such land.

Subd. 3. JUDICIAL ACTION. (a) The commissioner is charged with the duty of enforcing sections 18A.21 to 18A.45 and any rules thereunder. In the event a county attorney refuses to act on behalf of the commissioner the attorney general may so act.

(b) The commissioner may bring an action to enjoin a violation or threatened violation of sections 18A.21 to 18A.45 or any rule thereunder in a court of competent jurisdiction of the county in which such violation occurs or is about to occur.

(c) The commissioner when he believes that the public interest will be served best by so doing may seek to remedy minor violations by a suitable notice of warning in writing.

(d) The commissioner, after notice and hearing, may revoke, suspend or refuse to renew a registration, license, or certificate when a person is in violation of sections 18A.21 to 18A.45 or rules thereunder.

Sec. 18A.33. SUBPOENAS. The commissioner may issue subpoenas to compel the attendance of witnesses or production of books, documents and records in any hearing affecting the authority or privilege granted by a license, registration, certification, or permit issued under sections 18A.21 to 18A.45.

Sec. 18A.34. COOPERATIVE AGREEMENTS. The commissioner is authorized to enter into cooperative agreements with federal and state agencies for training, certification, and enforcement programs.

Sec. 18A.35. PROTECTION OF TRADE SECRETS. Subdivision 1. In submitting data required by sections 18A.21 to 18A.45, the applicant may:

(a) Clearly mark any portions thereof which in his opinion are trade secrets, commercial, or financial information; and

(b) Submit such marked material separately from other material.

Subd. 2. The commissioner shall not make any information public which in his judgment contains or relates to trade secrets or to commercial or financial information and obtained from a person who marked it privileged or confidential. When necessary, information relating to formulas of products may be revealed to any state or federal agency consulted and may be revealed at a public hearing or in findings of facts issued by the commissioner.

Subd. 3. If the commissioner proposes to release information which the applicant or registrant believes to be protected from disclosure under subdivision 2 he shall notify the applicant or registrant by certified mail. The commissioner shall not make the information available for inspection until 30 days after receipt of the notice by the applicant or registrant. During this period the applicant or registrant may institute an action in an appropriate court for a declaratory judgment as to whether such information is subject to protection under subdivision 2.

Sec. 18A.36. FINANCIAL RESPONSIBILITY. Subdivision 1. Prior to issuance or renewal of a commercial applicator license or structural pest control applicator registration or license, the applicant shall furnish proof of financial responsibility of net assets equal to or greater than $50,000, or by means of a performance bond or insurance covering the applicant's pest control activities in an amount determined by the commissioner. Such bond or insurance shall cover a period of time at least equal to the term of the applicant's license or registration. The commissioner shall immediately suspend the license of anyone failing to maintain the required bond or insurance. The performance bond or insurance policy shall contain a provision requiring the insurance or bonding company to notify the commissioner ten days prior to the effective date of cancellation, termination or any other change of the bond or insurance. In the event of any recovery against the bond or insurance, additional coverage shall be secured so as to maintain financial responsibility equal to the original amount required.

Subd. 2. An employee of a registered or licensed person need not maintain an insurance policy or bond during the time when his employer is maintaining the required insurance or bond.

Subd. 3. Applications for reinstatement of a registration or license suspended under the provisions of this section shall be accompanied by proof of satisfaction of judgments previously rendered.

Sec. 18A.37. INCIDENTS. The commissioner is authorized to apply appropriate and efficient procedures to contain and control pesticides involved in an emergency, which is an incident likely to cause adverse effects on the environment. For purposes of this section an incident includes a flood, fire, tornado, or motor vehicle accident, which unintention-

ally releases pesticides on the environment. Persons involved in or responsible for an incident shall report the incident to the commissioner immediately on discovering the incident. The department of agriculture shall be the lead government agency for decisions involving the emergency.

Sec. 18A.38. AGENT FOR SERVICE OF PURPOSE. All nonresident commercial and structural pest control applicator licensees licensed as individuals shall appoint the commissioner as the agent upon whom all legal process may be served and service upon the commissioner shall be deemed to be service on the licensee.

Sec. 18A.39. DELEGATION OF DUTIES. The functions vested in the commissioner by sections 18A.21 to 18A.45 may be delegated by him to such employees or agents of the department as he may from time to time designate.

Sec. 18A.40. RECIPROCAL AGREEMENT. The commissioner may waive all or part of the examination requirements provided for in sections 18A.21 to 18A.45 on a reciprocal basis with any other jurisdiction which has substantially the same requirements. Licenses or certificates issued pursuant to this section may be suspended or revoked upon suspension or revocation of the license or certificate of another jurisdiction supporting the issuance of a Minnesota license or certificate and in the same manner as other licenses and certificates.

Sec. 18A.41. DISPOSITION OF FUNDS. All moneys received by the commissioner under the provisions of sections 18A.21 to 18A.45 shall be deposited in the state treasury to the credit of the general fund.

Sec. 18A.42. UNSATISFIED JUDGMENTS. No applicant for commercial or structural pest control applicator license nor any commercial or structural pest control applicator licensee shall permit any final judgment against him for damages arising out of his carrying on pesticide application operations for hire to remain unsatisfied for a period of more than 30 days. The commissioner shall suspend the registration or license of any person for failure to satisfy within 30 days a final judgment resulting from pest control activities.

Sec. 18A.43. ADOPTION OF RULES. Subdivision 1. The commissioner is authorized to adopt rules necessary for the enforcement of sections 18A.21 to 18A.45 including, but not limited to, the following:

(a) The declaration of any form of plant or animal life which is injurious to health or the environment as a pest, other than man and other than bacteria viruses and other micro-organisms on or in living man or other living animals.

(b) The collection, examination and reporting of samples of pesticides.

(c) The safe handling, transportation, storage, display, distribution, and disposal of pesticides and their containers.

(d) The labeling requirements of all pesticides required to be registered under sections 18A.23 and 18A.24.

(e) The prescription of methods to be used in the application of pesticides, including the designation of a pesticide as a restricted use pesticide where the commissioner finds that it is necessary to protect the environment and to carry out the purpose and intent of sections 18A.21 to 18A.45.

(f) The requirement that any pesticides registered be colored or discolored if it is determined that such requirement is feasible and is necessary for the protection of the environment.

(g) The establishment of standards for packages and wrappings of pesticides registered for special local needs.

(h) The determination of state restricted use pesticides for the state or for designated areas within the state for the purpose of uniformity and in order to enter into cooperative agreements.

(i) The amount of performance bond or liability insurance required pursuant to section 18A.36.

Subd. 2. Rules adopted pursuant to sections 18A.21 to 18A.45 shall not permit any pesticide use which is prohibited by FIFRA and regulations or orders issued thereunder.

Subd. 3. Rules adopted pursuant to sections 18A.21 to 18A.45 and relating to certified applicators of restricted use pesticides, special local needs registrations, and experimental use permits shall not be inconsistent with the requirements of FIFRA and regulations promulgated thereunder.

Sec. 18A.44 PRIOR LIABILITY. Sections 18A.21 to 18A.45 shall not terminate or in any way modify any civil or criminal liability for an act of commission or omission occurring prior to January 1, 1977.

Sec. 18A.45. PENALTIES. Subdivision 1. Any person violating sections 18A.21 to 18A.45 or rules thereunder is guilty of a misdemeanor for the first violation and a gross misdemeanor for any subsequent violation.

Subd. 2. If there was no probable cause for an administrative action, including the issuance of a stop sale, use, or removal order, a court may allow recovery for damages caused by the administrative action.

p. d.

exhibit a.

MINNESOTA STATUTES
CHAPTER 399
MOSQUITO CONTROL

Sec.

399.01 Definitions

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Tables of Local Laws enumerating municipalities affected by local laws appear in the session law and statute volumes published by the State of Minnesota.

399.01 Definitions

Subdivision 1. As used in sections 399.02 and 399.12, the terms defined in this section shall have the meanings given them.

Subdivision 2. "District" means a metropolitan mosquito control district created pursuant to sections 399.02 to 399.12. The area of the district is the

area of the counties which elect to come within it as hereinafter provided.

Subdivision 3. "Commission," unless otherwise specified, means a metropolitan mosquito control commission which is the governing body of the district, and is authorized to exercise the powers enumerated in sections 399.02 to 399.12.

Subdivision 4. "Commissioner" means a member of the commission.

Subdivision 5. "Eligible counties" means the counties which have now joined together in a joint agreement to control mosquitos, and such counties are the counties of Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington.

Subdivision 6. "Contiguous county" is a county which is contiguous to any of the counties named in subdivision 5.

Laws 1959, c. 488, p. 1.

HISTORY AND SOURCE OF LAW

TITLE OF ACT

An Act relating to the control of mosquitos; authorizing a metropolitan mosquito control commission in the counties of Anoka, Dakota, Hennepin, Ramsey, Scott, and Washington, and counties contiguous thereto; providing for the levy and disbursement of taxes for the operation of the commission. Laws 1959, c. 488.

CROSS REFERENCES

Mosquito abatement, see PP. 18.041 - 18.161.

LIBRARY REFERENCES

Agriculture Key 9. C.J.S. Agriculture P. 30 et seq.

399.02 Establishment of district

Any two or more of the aforementioned eligible counties are hereby authorized to establish a metro-

politan mosquito control district in order to continue to control mosquitos in the district.

Laws 1959, c. 488, p. 2.

LIBRARY REFERENCES

Counties Key 18. C.J.S. Counties P. 41.

399.03 Commission

Subdivision 1. The district shall be operated by a commission which shall consist of two members from each county within the district. Commissioners shall be members of the board of county commissioners of their respective counties, and shall be appointed by their respective boards of county commissioners.

Subdivision 2. The terms of the members of the first commission shall expire on December 31 next following their appointment. Thereafter the terms of the commissioners shall be one year commencing on January 1 of each year.

Subdivision 3. If a vacancy occurs on the commission, it shall be filled by the appropriate board of county commissioners.

Subdivision 4. A person appointed to the commission shall qualify as a commissioner by filing with the director of the commission a written certificate of appointment from his county auditor, together with a written acceptance of the appointment; provided that the members of the first commission shall file in the office of the county auditor of Hennepin county.

Subdivision 5. The commission shall meet on the first Thursday after the first Monday in January of each year in order to select the officers of the commission for the current year and to conduct such other organizational business as may be necessary.

Subdivision 6. The officers, who shall be commissioners, shall be a chairman, a vice chairman, and a secretary, no two of whom shall be

from the same county. The chairman shall preside at all meetings of the commission, and in his absence, the vice chairman shall preside. The secretary shall keep a complete record of the minutes of each meeting.

Subdivision 7. Contracts and other written instruments of the commission shall be signed by the chairman or vice chairman and by the business administrator of the commission pursuant to authority from the commission.

Subdivision 8. The commission may adopt bylaws to regulate its own proceedings.

Subdivision 9. Each county in the district shall have one vote. Each commissioner shall have one-half vote, but if only one commissioner from a county is present, he shall have one full vote. The majority of the voting power of the commission shall be a quorum although a smaller number may adjourn from time to time. Any motion other than adjournment shall be favored by a majority of the voting power of the commission in order to carry.

Laws 1959, c. 488, P. 3; Laws 1967, c. 551, P. 1.

HISTORY AND SOURCE OF LAW

Prior to the 1967 amendment, subdivision 5 of this section read: "The commission shall first meet immediately after its appointment at the call of the chairman of the county board of Hennepin County to elect its officers. Thereafter the selection of officers shall be made at the first meeting in January of each year." Laws 1967, c. 551, P. 7, provided that this act (amendment of Minn. St. 1965, Chapter 399) shall become effective only after its approval by a majority of the members of the Metropolitan Mosquito Control Commission (approved June 14, 1967), and upon compliance with the provisions of P. 645.021.

LIBRARY REFERENCES

Counties Key 41. C.J.S. Counties P. 75.

NOTES OF DECISIONS

1. In general
Commissioner of Metropolitan Mosquito Control district is not a public employee as used in P.E.R.A. Op. Atty. Gen., 331-B, Aug. 14, 1967.

399.04 Powers and duties

Subdivision 1. The commission shall have the powers and duties set forth in this section.

Subdivision 2. It may take measures to control mosquitos in the district in accordance with expert and technical plans.

Subdivision 3. It may employ and fix the duties and compensation of a director who shall develop the mosquito control program of the district and shall supervise its execution; such director shall be an entomologist.

Subdivision 4. It may employ and fix the duties and compensation of a business administrator who shall administer the business affairs of the commission.

Subdivision 5. It may employ such other persons and contract for such other services as may be needed to carry out the program of the commission for mosquito control in the district, except that no person may be employed by the commission who is related to any commissioner.

Subdivision 6. It may reimburse commissioners and employees for expenses necessarily incurred or paid in performance of their duties and provide reasonable per diem.

Subdivision 7. It may purchase materials, supplies, and equipment as may be necessary to carry out the program of the commission for mosquito control in the district.

Subdivision 8. It may accept gifts of property for mosquito control purposes.

Subdivision 9. It may sell and dispose of any of the property of the commission whenever such property

is no longer needed for the purpose of the commission. If the estimated value of any such property is over $2,500, it shall be sold on competitive bids after two weeks published notice.

Subdivision 10. It shall keep proper minutes of all its proceedings which shall be open to public inspection at all reasonable times.

Subdivision 11. It shall keep proper and adequate books of account showing all its receipts and disbursements by date, source, and amount.

Subdivision 12. It may obtain suitable, proper, and adequate public liability and workmen's compensation insurance and such other insurance as it deems necessary.

Subdivision 13. It may enter into agreements with counties, cities, villages, boroughs, or towns of the state of Minnesota outside of the district to conduct mosquito control activities in these political subdivisions in order to effectuate mosquito control in the district.

Subdivision 14. It may collect and receive from all counties in the district the money for operation of the district.

Subdivision 15. It may perform whatever other acts are reasonable and necessary to carry out the general and specific powers of the commission.

Subdivision 16. It may require employees of the commission who handle commission funds to furnish surety bonds in such amount as is determined by the commission.

Subdivision 17. Members of the commission, its officers, and employees, while on the business of the commission, may enter upon any property within the district at reasonable times to determine whether mosquito breeding exists thereon, and such persons may take all necessary and proper steps for the control of mosquitos on such property as the director of the commission may designate. Subject to the paramount control of the county and state authorities, commission members and 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 mosquitos within the district. Such persons may spray with insecticides approved by the director any area within the district that is found to be a breeding place for mosquitos.

Subdivision 18. Repealed. Laws 1963, c. 798, P. 16.

Laws 1959, c. 488, P. 4; Laws 1967, c. 551, P. 2.

HISTORY AND SOURCE OF LAW

Subdivision 18 related to liability of the commission for tort, etc. See, now, P. 466.01 et seq. For coded text of repealer see P. 466.16. For the effective date see P. 466.17.

The 1967 amendment increased the competitive bid limitation in Subdivision 9 from $500 to $2500.

Laws 1967, c. 551, P. 7, provided that this act (amendments of Minn. St. 1965, Chapter 399) shall become effective only after its approval by a majority of the members of the Metropolitan Mosquito Control Commission approved June 14, 1967) and upon compliance with the provisions of P. 645.021.

CROSS REFERENCES

Tort liability, political subdivisions, see P. 466.01 et seq.

LIBRARY REFERENCES

Counties Key 47. C.J.S. Counties P. 81.

NOTES OF DECISIONS

1. In general

Commissioner of Metropolitan Mosquito Control district is not a public employee as used in P.E.R.A. Op. Atty. Gen., 331-B, Aug. 14, 1967.

A village council does not have the authority to prohibit the metropolitan mosquito control district, or its agents, from spraying D.D.T. in accordance with the statutory direction to the mosquito control districts. Op. Atty. Gen., 471f, Sept. 24, 1965.

Two bids submitted to the Metropolitan Mosquito Control Commission with only one check, contrary to the specifications, would necessitate the rejection of both of the bids. Op. Atty. Gen., 707A-3, April 6, 1961.

399.05 Contracts for materials, supplies and equipment

No contract for the purchase of materials, supplies, and equipment costing more than $2,500 shall be made by the commission without publishing the notice once in the official newspaper of each of the counties in the district that bids or proposals will be received. The notice shall be published at least ten days before bids are opened. Such notice shall state the nature of the work or purchase and the terms and conditions upon which the contract is to be awarded, naming therein a time and place where such bids will be received, opened, and read publicly. After such bids have been duly received, opened, read publicly, and recorded, the commission shall award such contract to the lowest responsible bidder or it may reject all bids. Each contract shall be duly executed in writing and the party to whom the contract is awarded may be required to give sufficient bond to the commission for the faithful performance of the contract. If no satisfactory bid is received the commission may readvertise. The commission shall have the right to set qualifications and specifications and to require bids to meet such qualifications and specifications before bids are accepted. If the commission by an affirmative vote of five-sixths of the voting power of the commission shall declare that an emergency exists requiring the immediate purchase of materials or supplies at a cost in excess of $2,500 but not to exceed $5,000 in amount, or in making emergency repairs, it shall not be necessary to advertise for bids, but such material, equipment, and supplies may be purchased in the open market at the lowest price available without securing

formal competitive bids. An emergency as used in this section shall be an unforeseen circumstance or condition which results in placing life or property in jeopardy. All contracts involving employment of labor shall stipulate terms thereof and such conditions as the commission deems reasonable as to hours and wages.

Laws 1959, c. 488, P. 5; Laws 1967, c. 551, P. 3.

HISTORY AND SOURCE OF LAW

The 1967 amendment increased the amount of the contract limitation from $500 and $2500 and modified the publication of notice provision.

Laws 1967, c. 551, P. 7, provided that this act (amendments of Minn. St. 1965, Chapter 399) shall become effective only after its approval by a majority of the members of the Metropolitan Mosquito Control Commission (approved June 14, 1967) and upon compliance with the provisions of P. 645.021.

LIBRARY REFERENCES

Counties Key 116. C.J.S. Counties P. 183.

399.06 Adverse interest of commissioners

No commissioner shall have any personal or financial interest in any sale, lease or other contract made by the commission nor shall he benefit therefrom directly or indirectly. Any violation of this section may make such sale, lease, or other contract void. Upon conviction for a violation of this section a commissioner shall be automatically disqualified from further service on the commission.

Laws 1959, c. 488, P. 6.

LIBRARY REFERENCES

Counties Key 122(2). C.J.S. Counties P. 192.

399.07 Financing

Subdivision 1. The method of providing funds for the commission shall be as set forth in this section.

Subdivision 2. Each county in the district shall levy a special tax each year in order to defray its share of the cost of the activities of the commission, which share shall be based on population. This levy shall not exceed two mills in any year in excess of charter or statutory millage limitation and shall not exceed 50 cents per capita within the county making the levy. Such per capita limitation shall be calculated on the basis of the last decennial or special federal census. Such levy where necessary may be made separate from the general levy of the county and may be made at any time of the year, however, no participating county shall levy any tax for mosquito control except under sections 399.01 to 399.12

Subdivision 3. Each county in the district shall turn over to the commission all proceeds of such special tax and any subsequent special tax immediately after such proceeds are received, to be deposited in a bank or banks designated by the commission as its official depository, in an account to be known as the metropolitan mosquito control fund; and such funds may only be expended by the commission for the activities of the commission. Any bank or trust company so designated shall qualify as a depository by furnishing a corporate surety bond or collateral as required by Minnesota Statutes, Section 118.01, and shall thereafter, as long as money of the commission in excess of $10,000 is on deposit therein, maintain such bond or collateral in the amounts required by said section. However, no bond or collateral shall be required to secure any deposit; insofar as it is insured under federal law as provided in Minnesota Statutes, Section 118.10. Any county which issues certificates of indebtedness in anticipation of the collection and payment of such special tax shall deposit the funds procured thereby in the metropolitan mosquito control fund and said county shall redeem these certificates of indebtedness out of the special tax levy provided in this section. Any balance shall be deposited in the metropolitan mosquito control fund. All disbursements made pursuant to sections 399.02 to 399.12 shall be made from said fund upon order of the commission signed by the chairman or vice chairman and by the business administrator, and each claim voucher shall be

signed by the business administrator and shall specify the name of the payee, the amount to be disbursed, and the purpose of the disbursement.

Laws 1959, c. 488, P. 7; Laws 1963, c. 148, P. 1; Laws 1967, c. 551, P.P. 4,5.

HISTORY AND SOURCE OF LAW

The 1963 amendment added the second and third sentences to subdivision 3, effective July 1, 1963.

The 1967 amendment changed the reference in subdivision 2 from the "last official federal census" to the "last decennial or special federal census" and substituted "claim voucher" for "warrant" in the last sentence of subdivision 3.

Laws 1967, c. 551, P. 7, provided that this act (amendments of Minn. St. 1965, Chapter 399) shall become effective only after its approval by a majority of the members of the Metropolitan Mosquito Control Commission (approved June 14, 1967) and upon compliance with the provisions of P. 645.021.

LIBRARY REFERENCES

Counties Key 154 1/2. C.J.S. Counties P. 229.

399.08 Counties, County Officers

County participation, termination; dissolution. No county may terminate its participation in the district except by giving 12 months notice to the chairman of the commission. In the event a county terminates its participation in the district as provided in this section an appraisal of the property of the commission shall be made by a board of appraisers and the value determined as of the date of such termination. The board of appraisers shall consist of three members, one of which shall be appointed by the terminated county, one by the remaining counties within the district, and the third by the other two members of the appraisal board. In the event that the two appraisers cannot agree as to the appointment of the third appraiser within a period of 30 days

then and in that event the matter should be referred back to said commission and the commission should then have the authority to appoint the third appraiser. There shall be paid over to the treasurer of the terminated county an amount equal to that county's share in the net assets of the commission proportionate to its financial contribution to the metropolitan mosquito control fund. In the event of the dissolution of the district all property of the commission shall be sold and the proceeds of such sale remaining after payment of all debts, obligations and liabilities of the district, along with any balance in the fund, shall be divided and paid over to the county treasurers of the respective counties which are then members of the district in proportion to their undivided interest computed as above specified.

Laws 1959, c. 488, P. 8; Laws 1967, c. 551, P. 6.

HISTORY AND SOURCE OF LAW

Prior to the 1967 amendment this section read:

Any county may terminate its participation in the district by written notice given to the chairman of said commission on or before July 1 of any year and such termination shall become effective on January 1, of the following year. In the event of the dissolution of the district all property of the commission shall be sold and the proceeds of such sale remaining after payment of all debts, obligations, and liabilities of the district, along with any balance in the fund, shall be divided and paid over to the county treasurers of the respective counties which are then members of the district in proportion to their undivided interest computed as above specified. In the event a county terminates its participation in the district as provided in this section an appraisal of the property of the commission shall be made by a board of appraisers and the value determined as of the date of such termination. The board of appraisers shall consist of three members, one of which shall be appointed by the terminated county, one by the remaining counties within the district, and the third by the other two members of the appraisal board. In the event that the two appraisers cannot agree as to the appointment of the

third appraiser with a period of 30 days then and in that event the matter should be referred back to said commission and the commission should then have the authority to appoint the third appraiser. There shall be paid over to the treasures of the terminated county an amount equal to that county's share in the net assets of the commission proportionate to its financial contribution to the metropolitan mosquito control fund.

Laws 1967, c. P. 7, provided that this act (amendments of Minn. St. 1965, Chapter 399) shall become effective only after its approval by a majority of the members of the Metropolitan Mosquito Control Commission (approved June 14, 1967) and upon compliance with the provisions of P. 645.021.

399.09 Compensation of commissioners

Each commissioner, including the officers of the commission shall be reimbursed for his actual and necessary expenses incurred in the performance of his duties. The chairman shall be paid a per diem for attending meetings, monthly, executive, and special, and each commissioner shall be paid a per diem for attending meetings, monthly, executive, and special, which per diem shall be established by the commission, such expense reimbursement and per diem notwithstanding any other funds which such commissioners may receive from any other public body.

Laws 1959, c. 488, P. 9.

LIBRARY REFERENCES

Counties Key 46. C.J.S. Counties P. 79.

CROSS REFERENCES

Mileage allowances, see P. 15A.20.

399.10 Contiguous counties: membership

Any county contiguous to the district may become a party to the district whenever the county board of such county petitions the district to be

admitted and the commission by resolution gives its consent to include such county in the district.

Laws 2959, c. 488, P. 10.

399.11 Cooperation with other agencies: advisors

Subdivision 1. The commission shall cooperate for the purposes of research and protection of public health and welfare, with the state department of agriculture, the state department of health, the state department of conservation, the university of Minnesota, the state agricultural experiment station, the state highway department, the U. S. department of agriculture, and U. S. public health service.

Subdivision 2. The commissioners of agriculture, of conservation, of highways, the secretary and executive officer of the Minnesota department of health, and the head of the department of entomology and economic zoology of the university of Minnesota shall act in an advisory capacity to the metropolitan mosquito control commission and the director of said commission shall furnish to each of these departments a copy of the operational plan and pertinent technical reports of said district.

Laws 1959, c. 488, P. 11: Laws 1961, c. 113, P. 1.

399.12 Eligible counties must approve

Sections 399.01 to 399.12 shall be effective as to any eligible county or any contiguous county only after its approval by a majority vote of the governing body of such county. When and at such time as this approval is given, then the district consisting of the eligible counties shall have the authority to take over the assets of the contractually formed commission which heretofore existed.

Laws 1959, c. 488, P. 12.

HISTORY AND SOURCE OF LAW

Approval Filed

Anoka County----------May 26, 1959
Dakota County----------May 18, 1959
Hennepin County----------May 6, 1959
Ramsey County----------May 18, 1959
Scott County----------May 18, 1959
Washington County----------May 14, 1959

CHAPTERS 400-409 RESERVED

INDEX

CONSULT M.S.A. GENERAL INDEX

END OF VOLUME

exhibit b.

M.M.C.D. RESEARCH PRIORITIES

INTRODUCTION

It is the conviction of the present M.M.C.D. Director that the use of insecticides in the District program should be considered a temporary measure until such time as alternative means of control for each mosquito habitat can be developed and proven operationally feasible and cost effective. No matter how safe these formulations, it is highly preferable to correct the ecological imbalance. In 1974 a re-evaluation of the District program resulted in approval and funding of a pilot research program to explore the potential of four research areas which held promise as alternatives to current use of insecticides. The progress which has been made in each of these areas will be discussed in the following text. Consideration of the mosquito annoyance contributed by the top ten mosquito species in the Metropolitan Area identifies the long-term program needs and thus goals for non-chemical control measures.

It can readily be seen that the overall contribution which Aedes vexans makes to the annoyance problem makes it the most important mosquito species. When the number of breeding sites producing this species and its extensive flight range are considered, the importance of the Aedes vexans looms even larger. This species is primarily produced in Type I sites but will also produce in Type III and river bottom locations.

The seven univoltine or spring Aedes mosquito species can be grouped together with regard to: (a) moderate flight range; (b) a 3 to 5 month life span; and most importantly, (c) the type of woodland habitat (Type II) in which they are produced.

Coquillettidia perturbans is noted for its particularly aggressive biting behavior during the middle of the summer, as its one generation per year emerges from lakes and marshes. It is especially notable because larval control is not now feasible for this species.

Finally, in times of large flood backwaters (usually twice a year), Aedes sticticus and Aedes trivittatus together with Aedes vexans become important.

PRIORITY DESCRIPTIONS

It can be seen from the above discussion that, in terms of program priorities, first priority must be placed on a means of reducing the production of Aedes vexans in Type I and Type III breeding sites. Both these sites lend themselves, to a great extent, to being ultimately controlled by non-chemical means.

The spring Aedes breeding sites are created by the impermeable frost layer which holds snow melt run-off in woodland pools. This habitat requires further thought and study to determine alternative means of control. Frankly, controlling these species through natural enemy complexes is doubtful at this time due to the cold water temperatures which reduce predator metabolism. No good physical control alternatives are known at this time.

Higher expectations are possible, however, in regard to the lake and marsh breeding mosquito Coquillettidia perturbans. It may ultimately be possible to reduce the production of this mosquito species approximately 50% through manipulation of natural enemy complexes. Such a reduction would be a substantial improvement over current control. This mosquito has an unusual biology in that it is attached to the roots of marsh vegetation up to 3 feet below the water surface for the duration of its larval development, instead of developing near the surface (Barr, 1958). This has restricted the potential of insecticide control due to the chemical reducing environment of the larvae.

The fluctuating and temporary nature of the river bottom flood water habitat does not lend itself readily to biological control. However, physical modifications in drainage or shoreline hold potential where environmentally feasible.

In the judgment of the District Director, the priorities of research needed to improve mosquito control in the Metropolitan area and ultimately reduce the current dependence upon insecticides,

within the current funding levels, are reflected by the pilot research programs in progress. These priorities are based on two premises: 1) Chemical control methods should be made more effective to free funding for permanent control; 2) Alternate methods should be developed and tested so they are ready as funds become available.

In practice, first priority has been given to developing a controlled-release mosquito larvicide which can be used to control Aedes vexans in non-draining Type I sites. One application of this formulation should control mosquitos for an entire year and enable the treatments to be made during the off-season and dry periods between mosquito broods during the mosquito season. This would enable more Type I sites to be controlled further out from the interior of the Twin Cities area resulting in less infiltration of adult mosquitos into the larval controlled core area. It would also enable employees to concentrate on reaching more Type I sites and Type III sites needing control. The reduced levels of mosquito annoyance thus possible without an increase in funding would meet the current need for improved control of adult mosquitos and provide the longer period of time required to develop alternative non-chemical control measures.

The second research priority has been investigations of non-chemical control alternatives for Type I sites. This was initiated concurrently with the control release investigation. To date this work has confirmed the effects of limestone applied to upland Type I sites to increase their rate of infiltration. Depressions which hold snow melt and rainwater runoff over the years, have formed lense layers from collodial materials carried in the runoff. These depressions have been found to be calcium deficient. Limestone applications to such upland mosquito breeding areas increase the rate of water percolation in certain soils via exchanging univalent hydrogen, sodium potassium and ammonium ions with bivalent calcium ions. One application at the correct dosage rate will prevent mosquito breeding in the estimated 14,000 small breeding areas within 5 years of application and remain effective for 15-20 years

with one application. Due to the high productivity of such sites, their elimination could reduce the mosquito problem 40 percent in the Metropolitan area. While this treatment does not alter the size, shape, or drainage pattern into the site, it does result in drying of the site prior to completion of larval development.

Another research effort on this type of site has included constructing a ditch around small Type I sites to catch surface runoff water and allow it to sink into the ground prior to reaching the impermeable bottoms of the depressions.

The third research priority involves the development of a biological pest management program to control Aedes vexans in Type III sites. Only 23,725 acres (9.8%) of all mosquito breeding areas within the District hold water continuously during normal years. Another 59,741 acres (24.7%) are similar to Type III sites, except that they normally dry up during July and August.

As these 59,741 acres dry, the natural enemies of the mosquito are killed; yet mosquito eggs remain ready to hatch upon reflooding. Unfortunately, natural enemy complexes do not hatch upon reflooding. Most forms must fly in from adjacent permanent bodies of water. It normally requires a minimum of 6 weeks for re-invading natural enemies to build up to a level which will provide any meaningful control. Furthermore, if a site dries up in the fall, natural enemies cannot over-winter in the site, nor can they re-invade and build to supress mosquito populations until mid summer when warm temperatures encourage their movement. It is at this very time that the normal mid summer drought occurs, the site dries up again, and the beneficial impacts of natural predators may last only 4 to 6 weeks each year.

The first rule of biological control is that natural insect enemy complexes present in an environment must be identified prior to the introduction of natural enemies not native to the local area. In 1975, an empirical study of the native insect species present in Type III sites and their seasonal population dynamics was begun; results will be available in late 1977.

Six permanent water mosquito production areas have been studied biweekly via the use of a quantitative water column sampler for insects in shallow aquatic habitats (Legner et al., 1975). Following the determination of the most effective natural predatators, work on the development of mass culture and storage methods for the most effective predators is planned. Following this data gathering phase, analysis will be conducted to determine the real impact of predatious forms on mosquito larvae during various periods of the year. Incidentally, periods when augmentation by mosquito predators not native to this area will be necessary to achieve desired levels of mosquito control will become known.

Field observations thus far of naturally occurring insect populations in Type III sites during 1975 and 1976 have suggested that the water quality (i. e., water chemistry) determines the type and variety of aquatic vegetation present in Type III sites, as well as the maximum densities of aquatic insect fauna that Type III sites are able to support.

It appears that the water quality of Type III sites is a function of soil type in each mini-watershed. Replacement of trace quantities of deficient nutrients may enable the development and support of increased aquatic insect populations beneficial to both wildlife and mosquito control. Dr. John Moyle of the Department of Natural Resources, now retired, has provided much of the ground work in this area.

Ultimately Type III sites hold potential for control of mosquitos through manipulation of laboratory-cultured natural enemies of mosquitos. Early spring innoculative releases of predators and inundative releases of natural enemies would act as "living insecticides." This approach will be costly and the technology required to mass-culture biological control agents known to be effective in controlling mosquitos is in its infancy.

However, the importance of Type III sites as wildlife habitats and their larger average size justifies

the increased expense required to control them with non-chemical means. It should be recognized that a 75-90% mosquito control level achieved by biological organisms would be considered good in contrast to the 95 to 98% control achieved through the use of insecticides. Combined with a more effective Type I control program, mosquito annoyance could be effectively reduced.

Included in the pest management research needs for Type III sites is the development of environmentally acceptable physical modification measures which would in large part reduce the extensive mosquito egg laying regions naturally occurring in these sites while improving their capacity to hold water year round. Suggested types of physical modifications are discussed under Alternative Programs. Studies on the impact of the proposed physical modifications would be required prior to their use in an operational control program.

The fourth research priority must be directed at the control of the marsh and lake breeding mosquito , Coquillettidia perturbans. The production of this mosquito in lakes and marshes within the interior of the Metropolitan area in close proximity to highly urbanized areas, and the mosquito's severe pest nature dictate that a pest management system be developed for it. Aspects of the biological control research directed towards the breeding of Aedes vexans in Type III sites may be applicable to control of this species. However, it is expected that extensive studies directed specifically at the habitat requirements of this species will be required to understand the best means of suppressing populations through use of natural enemies. It will be necessary to conduct detailed surveys of Coquillettidia perturbans habitats in Minnesota, and possibly states to the south, to determine what predators of this species occur and what degree of control each is capable of exerting on the population.

At present, the most promising known alternatives appears to be the innoculation of hydra into the breeding sites of this species in the early summer. This will enable the hydra to reach high densities by the time Coquillettidia perturban mosquitos are laying

eggs (between mid July and early August). As these mosquito egg hatch, hydra may consume a substantial portion of the following year's crop as they drift down to attach onto the roots of aquatic vegetation. Once attached and breathing through the interior of the plant, a natural enemy likely to search out and destroy the attached larvae may be the flatworm, planaria.

COST/EFFECTIVENESS OF RESEARCH PROGRAMS

At this point in the pilot research programs, additional research work on these projects is somewhat confined by funding limitations. Should additional research work be done, the anticipated effort required, costs, and financial return through operational savings are as follows.

DEVELOPMENT OF CONTROLLED RELEASE FORMULATION

Five differentially crumbling silicate controlled release formulations have been developed jointly by Dr. Curt Thies, Washington University, St. Louis, and M.M.C.D. staff. Preliminary laboratory tests have indicated that the formulations achieve the release rate required for a field control program (Sjogrenand Thies, 1976; Schandle et al., 1976; Schandle, 1976). Additional laboratory tests on reduced loadings and under simulated alternate flooding and drying conditions are required. Extensive small plot field evaluations also need to be conducted to determine the duration of control for each formulation at different loading levels.

When the development and evaluation phases are completed, a petition for operational evaluation through a special use registration must be made to the Environmental Protection Agency. A decision will need to be made as to the environmental suitability of using chlorpyrifos as the toxicant in the capsules or whether to devote full effort to development of a Dimilin controlled release formulation, recognizing its lower vertebrate non-target toxicity.

To date evaluations have been conducted on both chlorpyrifos and Dimilin. The projected time frame for developing this data to submit the

initial application to the EPA would be two years. Due to the inability of determining the ultimate requirements for EPA registration of such a formulation or the extent of additional information needed to meet those requirements, the research and development costs cannot be accurately determined beyond the projected two year initial period. The projected two year cost would be $30,000.00.

Once EPA registration is granted, it is proposed that the District would set up its own manufacturing facility utilizing District personnel trained in the manufacturing process to make the controlled release granules needed for the field program. Because of involvement of M.M.C.D. staff, the District currently holds formulation rights to the patent on the granule process. Thus the District could make the formulations in needed quantities during the winter months. The cost of setting up the formulation plant and employee training is projected at $12,000.00. The anticipated annual savings would be primarily in the area of labor and could free employees now required for multiple applications to control breeding areas which cannot be reached with current staffing levels.

In the fall of 1976, after the two year cooperative research program with Dr. Curt Thies had advanced to the point of developing the silicate control release formulation, Dow Chemical Company obtained registration on a chlorpyrifos, polyethylene plastic, controlled release formulation (Dursban 10CR). The formulation has received EPA registration and will provide control of Aedes vexans for an entire season or longer.

At this time a decision needs to be made whether to: 1) continue further development work on the silicate capsule formulation which is capable of incorporating a wide variety of toxicants into a more environmentally compatible and energy saving carrier than that of the polyethylene plastic or, 2) use the Dow Chemical formulation for the time required to develop non-chemical control alternatives

EFFECTS OF LIMESTONE APPLICATION ON SOIL PERMEBILITY

As noted in the Environmental Setting, the ability of Type I sites to hold water long enough to breed mosquitoes appears to be a function of low soil permeability. This soil condition is often linked to calcium deficiency. In the Western United States, applications of limestone to some soils have increased water infiltration rates for agricultural purposes. A review of the literature on the effects of calcium in relation to soil permeability has substantiated this phenomenon (Van Doren and Klingfiel, 1952; Aldrich and Schonover, 1951; Houston et al., 1955). Exceptions exist (Schaefer 1977).

To confirm the value of limestone applications to Type I mosquito breeding depressions in this area, applications were made in the fall of 1974 to 30 paired and geographically adjacent Type I mosquito breeding sites throughout the District. Both the treated and control sites were on record as being primary Aedes vexans breeding areas.

To study changes in permeability, four core tubes were taken in the fall of 1975 at random from within the 50% wet circumference. These were taken to a depth of eight inches, after removing the vegetation down to the mineral soil. The four replicates were taken from the treated and control sites in 18 of the 30 paired sites. Laboratory infiltration tests for 15 weeks confirmed that an increase of infiltration rate had occurred between treated and control sites, averaging 3.3 fold.

Laboratory chemical analyses are in progress to determine the relationship between soil types, percent organic matter, pH, texture, cation exchange capacity and exchangeable cations--calcium--to determine the relationships between these parameters and the rate of reclamation

which occurs under field conditions. Further research will determine the responses of the various soil types in terms of increased water permeability in relation to various dosages of calcium carbonate. This will help identify the rates of increased water permeability and the duration of the reclamation period.

The factors under consideration which may influence the maximum infiltration rate obtainable in each soil type are: quantity precipitation received (i.e., the amount of water which collects in a depression); the dosage rate of limestone applied; the depth of the impermeable soil layer; elapsed time of water retention before treatment; and the total cation exchange capacity (the percent of calcium required in proportion to the total exchangeable cation in a particular soil).

Two of the 30 field sites treated in the fall of 1974 failed to produce any mosquitos in the spring of 1976 during which time the control sites produced Aedes mosquitos. This rapid reclamation is considered abnormal and may reflect a shallow impermeable layer. Still, the early results are very encouraging. It is projected that a time frame for additional research needed to correctly calculate the dosage required for the various soil types within the District will require an additional 2-3 years of study at moderate annual costs.

STUDIES ON PHYSICAL SITE MODIFICATIONS IN MOSQUITO HABITATS

With the exception of several experiments on the excavation of a run-off collection ditch around Type I habitats, physical site modifications have not been included in the current research program. This is principally due to their high cost and the resistance associated with the physical changing of naturally occurring mosquito breeding sites. The types of physical modifications presented in the Ultimate Control Program Alternative hold potential in concept but have not been adequately assessed as to their impact on wildlife under Minnesota conditions. The concepts upon which a number of them are based originate from District experience,

(i.e., island moat changes) and mosquito control literature reporting such changes in other areas of the United States. The impact of the potential alternatives, especially slope modifications in Type III sites, would need to be determined in great detail prior to their use in an operational program.

NATURAL ENEMY COMPLEX STUDIES

As explained previously, to develop a natural enemy pest management program to control Aedes vexans in Type III sites, a study of the native benthic macroinvertebrate fauna was conducted during 1975 and 1976 in six Type III sites throughout the District. Samples were collected from June 1975 to the fall freeze and from the 1976 spring thaw until July 15th. A total of 3,075 samples were collected. Twenty-five column samples were taken from each field site on two week intervals and processed in the laboratory during winter months. From this study it will be possible to determine which aquatic insects that occur in the Metropolitan area might have potential value in controlling mosquitos. Specific analysis is being conducted currently by species, on their seasonal population dynamics, their densities in relation to water quality, and the effects of over-wintering mortality on the populations.

The role introduced natural enemies might play in suppressing mosquito larval populations is still not determined, however. Analysis of field data and determination of the relative predatory value of the predacious forms having the longest seasonal duration and highest native populations will require extensive biological studies over a 2-5 year period.

Due to the potential impact of water quality on the ability of a Type III site to support natural enemies it is essential that funds be devoted to understanding the relationships between water quality and aquatic food chains. If Type III breeding sites lack basic nutrients required to support aquatic predators, little will be gained by natural enemy introductions in a pest management

program. Indeed, such sites may hold less potential for control by natural enemies. Consensus approval will be required from State agencies to improve insect habitat in small mosquito breeding areas. It does hold the positive impact of overall improved food supply for wildlife. It is known that the chief ingredient often missing is water, due to the fact that so many Type III sites dry during the summer or fall. In the field, mosquito habitats which appear identical to the eye often support great differences in insect densities.

If we are to understand the reasons why some sites produce large numbers of mosquitos while other sites do not, and use this information to make environmentally sound physical changes in mosquito breeding sites, it is important that more emphasis be placed on determining the physical-chemical-biological factors which influence differences in site productivity under Minnesota conditions. Differences in conditions under which the research was conducted often prevent the direct interpretation of the value of the same organisms in northern climates. Accordingly, evaluations of potentially effective natural enemies should be conducted by Metropolitan Mosquito Control District staff in cooperation with specialists working on specific agents in other parts of the United States. Such evaluations require painstaking attention to detail and an awareness of factors potentially influencing success or failure. Thus staff trained in such evaluations are needed to determine the potential of each reported biological control agent to fit into the District program.

Outside of water quality-food chain relationships, mass culture and storage technology for proven natural enemies is still required before the future potential of biological control of mosquitos can be realized. It is important that this technology be developed to ensure the success of winter rearing of effective natural enemies for spring inoculation into mosquito breeding sites. Such inoculations should enable natural enemies to develop the population levels necessary to suppress mosquito hatches substantially earlier in the year than normally occur. Additionally, the availability of such populations to introduce in the spring to

Type III sites, normally dry in the late summer or fall, would favor controlling such sites biologically.

Finally, long term population dynamics studies will be required to understand the relationships existing between various mosquito population thresholds and those of natural control agents.

Table PD-1 contains a summary of the expected operational benefits of various program alternatives. All calculations are approximations. None include the cost of research that might be necessary to prepare for implementation. Generally, the most expensive research programs would be in natural enemy complexes and controlled release.

It is interesting to note the high cost effectiveness which could potentially apply to both limestoning and natural enemy treatments. Both these programs are characterized by the addition of materials already present, in smaller amounts, in their respective sites.

Another interesting fact that emerges is the relative contribution each program would make over time. The current program is projected to go from second in importance to last; biological changes from fifth to third.

It should be noted that yearly amortized costs may hide large costs at the beginning of the program. With the District's current organizational, operational and legal establishment, this is difficult to achieve.

Table PD-1

Projected Potential Benefits of Various Larval Control Research Programs (Assuming a $135,000 Research Budget and Ultimate Operational Program) Compared to the Current Program

Research Program	C.R.	L	P.C.	N.E.C.	C.P.
Greatest Benefit by Year	1980	1990	2002	1992	1977
Control Benefit by 1982*	1	3	4	5	2
Control Benefit by 1990*	1	2	5	4	3
Control Benefit by 2000*	4	1	2	3	5
Relative Research Efficiency*	1	2	3	4	0
Operational Cost Per Acre for 20 Years	$320	$50	$405	$300	$360
Yearly Amortized Cost/Acre 40 Years	$ 16.00	$ 2.50	$ 15.00	$ 5.00	$ 18.00
Cost Effectiveness By Year 2000 Compared to Current Program	1.1	7.2	1.2	3.6	1

*Ranked highest to lowest

LEGEND:
C.R. = Controlled Release
L. = Limestone
P.C. = Physical Changes
N.E.C. = Natural Enemy Complexes
C.P. = Current Program

exhibit c.

INSECTICIDE MIXING INSTRUCTIONS

Material Code 1 #2 fuel oil mixed with a designated spreading agent.

1. To be used as a larvicide in pastures or a pupicide only.

2. Mix accordingly with Foremans directions.

The following instructions apply to all of the mixing procedures which follow.

1. Only County Supervisors and Foremen will mix these materials.

2. Full protective gear--respirator, apron, goggles, gloves and boots shall be worm at all times by employees mixing concentrate materials.

3. Blend mixed material for 5 minutes with liquid agitator, before replacing cap on drum and storing.

4. All mixing should be done in 55 gallon drums.

5. If material is stored more than 2 days repeat blending process before using.

6. Store excess mineral oil in empty 55 gallon drums clearly labelled. Do not mix parts of drums.

7. Clearly mark each drum with the mixing date, name of the insecticide, material code number or numbers and, employee number of person mixing the material.

Material Code 17 Abate 4 lb. liquid concentrate mixed with specified diluent to be used as an air larvicide only. (.05 AI)

1. The mixture rate shall be 14.6 gallons of Abate 4 lb. liquid concentrate added to 40.4 gallons of diluent to yield 55 gallons of finished spray material.

Material Code 18 Dursban 4 lb. liquid concentrate mixed with mineral oil to be used as an air larvicide only. (0.025 AI)

1. The mixture rate shall be 7.3 gallons of Dursban 4 lb. liquid concentrate added to 47.7 gallons of mineral oil to yield 55 gallons of finished spray material.

Material Code 22 Dursban 4 lb. liquid concentrate mixed with mineral oil to be used as an air adulticide only. (0.025 AI)

1. The mixture rate shall be 4.4 gallons of Dursban 4 lb. liquid concentrate added to 50.6 gallons of mineral oil to yield 55 gallons of finished spray material.

Material Code 27 Dursban 4 lb. liquid concentrate mixed with diluent to be used as an air spring residual treatment material only. (0.05 AI)

1. The mixture rate shall be 14.6 gallons of Dursban 4 lb. liquid concentrate added to 40.4 gallons of mineral oil to yield 55 gallons of finished spray material.

Material Code 10 Resmethrin 40% liquid concentrate mixed with mineral oil to be used as a ground adulticide only. (0.0035 AI)

1. The mixture rate shall be 5 gallons of Resmethrin 40% liquid concentrate added to 50 gallons of mineral oil to yield 55 gallons of finished spray material.

Material Code 9 Resmethrin 40% liquid concentrate mixed with mineral oil to be used as a ground adulticide only. (0.007 AI)

1. The mixture rate shall be 1.9 gallons of Resmethrin 40% liquid concentrate added to 53.1 gallons of mineral oil to yield 55 gallons of finished spray material.

Material Code 5 Resmethrin 18.5% concentrate mixed with mineral oil to be used as a ground adulticide only. (0.0035 AI).

1. The mixture rate shall be 9.72 gallons of Resmethrin 18.5% liquid concentrate added to 39 gallons of mineral oil to yield 48.72 gallons of finished spray material.

Material Code 6 Resmethrin 18.5% concentrate mixed with mineral oil to be used as a ground adulticide only (0.007 AI)

1. The mixture rate shall be 4.0 gallons of Resmethrin 18.5% liquid concentrate added to 51 gallons of mineral oil to yield 55 gallons of finsihed spray material.

Material Code 7 Pyrethrum liquid concentrate mixed with mineral oil to be used as a ground adulticide only. (0.004 AI)

1. Mixture rate shall be 18.8 gallons of Pyrethrum liquid concentrate added to 36.2 gallons of mineral oil to yield 55 gallons of finished spray material.

MATERIAL CODE 1 - FUEL OIL

FORMULATIONS/USES:

May be used to control mosquito larvae in pastures, and as a general ground pupal treatment applied with 2 or 4 gallon sprayer in temporary water sites. Should be mixed with designated spreading agent, amount to be specified by your Foreman.

DOSAGE/APPLICATION RATES:

To be applied with uniform coverage at rates of up to 3 gallons per acre.

Sites with little vegetation require less than 3 gallons per acre to achieve uniform coverage.

LIMITATIONS:

Use as a larval control material is limited to pasture sites, and temporary water sites containing pupae.

SAFETY PRECAUTIONS:

This material should be transported on vehicles in 5 gallon jugs or in oil drums.

Material is flammable, do not use near open fire or flames. Clean up oil spills in truck beds daily to prevent slipping accidents.

Wash material from body with soap and water to prevent skin irritation from oil.

Do not walk into the wind while applying this material.

MATERIAL CODE 2-4-16-20 ABATE 1% ON CELATOM GRANULES

FORMULATIONS/USES:

May be used to control mosquito larvae in non-pasture ground and air sites.

All ground treatments will be made with the hand seeder, aerial treatments with the helicopter.

DOSAGE/APPLICATION RATES:

In ground applications, to be applied at the uniform rate of (2.5) or (5.0) lb. of material per acre. (0.025 AI) or 0.05 AI)

In aerial applications, to be applied at the uniform rate of (5.0) or (7.5) lb. of material per acre. (0.05 AI) or (0.075 AI)

LIMITATIONS:

Limited to non-pasture sites only.

SAFETY PRECAUTIONS:

Respirator, apron, goggles and gloves shall be worn by employees loading the helicopter.

Respirator apron and gloves shall be worn during loading of seeder and ground applications.

Material shall be transported on vehicles in garbage cans with covers securely fastened. The material should be kept in bags in the cans.

Material spills in vehicle or on ground shall be cleaned up daily.

When the material is transported on vehicles in bags, care should be taken to prevent tearing of bags in truck bed. Empty bags shall be transported to the county headquarters for proper disposal. Care should be taken to prevent empty bags from flying out of vehicle during transit.

MATERIAL CODE 12-13 DURSBAN 1% SAND GRANULES

FORMULATIONS/USES:

May be used as both ground spring residual and ground summer pre-hatch treatments to control mosquito larvae in nonsensitive, non-pasture sites only.

Ground treatment shall be made with the hand seeder.

DOSAGE/APPLICATION RATES:

In ground spring residual treatments, to be applied at the uniform rate of 5.0 lbs. of material per acre. (0.05 AI)

In ground summer pre-hatch treatments, to be applied at the uniform rate of 10.0 lbs. of material per acre. (0.1 AI)

LIMITATIONS:

Use is limited to nonsensitive and non-pasture sites only. This material should not be applied to sites which drain or run off into streams, lakes or rivers.

SAFETY PRECAUTIONS:

Apron and gloves shall be worn during the loading of seeders and during ground applications.

The material shall be transported on vehicles in garbage cans or drums with covers securely fastened to the container.

The granules should be kept in bags in the containers.

Material spills in the vehicles or on the ground shall be cleaned up daily.

MATERIAL CODE 25-26 DURSBAN 1% ON CELATOM GRANULES

FORMULATIONS/USES:

May be used as both air spring residual and air summer pre-hatch treatments to control mosquito larvae in nonsensitive, non-pasture sites only.

DOSAGE/APPLICATION RATES:

In air spring residual treatments to be applied at the uniform rate of 5.0 lbs. of material per acre. (0.05 AI)

In air summer pre-hatch treatments, to be applied at the unifrom rate of 10.0 lbs. of material per acre. (0.1 AI)

SAFETY PRECAUTIONS:

Respirator, apron, goggles and gloves shall be worn by employees loading the helicopter.

When the material is transported on vehicles in bags, care should be taken to prevent tearing of bags in truck bed.

Material spills in the vehicle or on the ground shall be cleaned up daily.

Empty bags shall be transported to the county headquarters for proper disposal. Care should be taken to prevent empty bags from flying out of vehicle during transit.

MATERIAL CODE 17 ABATE 4 LB. LIQUID

FORMULATIONS/USES:

May be used to control mosquito larvae in non-pasture air sites.

DOSAGE/APPLICATION RATES:

In aerial applications, to be applied at uniform rates of 6.0 fluid oz. of finished spray material per acre. The finished spray mixing rate is 34 fluid oz. Abate 4 lb. liquid concentrate in 94 fl. oz. specified diluent to yield 1 gallon finished spray material. (0.05 AI)

LIMITATIONS:

Limited to non-pasture sites only.

SAFETY PRECAUTIONS:

Apron, goggles, gloves and boots shall be worn by employees loading the helicopter. County Foremen shall load the helicopter.

Material shall be transported in truck beds in 5 gallon jugs or drums with hand pumps, with covers securely sealed and containers fastened in truck bed to prevent spillage.

Material spills in vehicle or in the shop shall be neutralized with soda ash immediately.

Do not walk on spilled material.

Avoid skin or clothing contact with this material; if contaminated, wash the contaminated part of body with soap and water immediately and change contaminated clothing.

MATERIAL CODE 18-22-27 DURSBAN 4 LB LIQUID

FORMULATIONS/USES:

May be used as an air larvicide, air adulticide and an air spring residual treatment to control mosquito larvae and adults in non-sensitive non-pasture sites only.

DOSAGE/APPLICATION RATE:

In air larvicide treatments, to be applied at the uniform rate of 6.0 fl. oz. of finished spray material per acre. The finished spray mixing rate is 17 fl. oz. Dursban 4 lb. liquid concentrate in 111 fl. oz. mineral oil, to yield 1 gallon of finished spray material. (0.025 AI)

In air adulticide treatments, to be applied at the uniform rate of 10.0 fl. oz. of finished spray material per acre. The finished spray mixing rate is 10.25 fl. oz. Dursban 4 lb.

liquid concentrate in 117.75 fl. oz. mineral oil to yield 1 gallon of finished spray material. (0.025 AI)

In air spring residual treatments, to be applied at the uniform rate of 6.0 fl. oz. of finished spray material per acre. The finished spray mixing rate is 34 fl. oz. Dursban 4 lb. liquid concentrate in 94 fl. oz. diluent to yield 1 gallon of finished spray material. (0.05 AI)

LIMITATIONS:

Limited to non-sensitive and non-pasture sites with the exception of material code 22. This material should not be applied to sites which drain or run off to streams, lakes or rivers. Foreman only shall load the helicopter.

SAFETY PRECAUTIONS:

Apron, goggles, gloves and boots shall be worn by employees loading the helicopter.

Material shall be transported in truck beds in 5 gallon jugs or drums with hand pumps with covers securely sealed and containers securely fastened in truck bed to prevent spillage.

Material spills in vehicle or in the shop shall be neutralized with soda ash immediately.

Do not walk on spilled material.

Avoid skin or clothing contact with this material; if contaminated wash material from contaminated part of body with soap and water immediately and change contaminated clothing.

MATERIAL CODE 3-8-19 MALATHION 5 LB LIQUID

FORMULATIONS/USES:

May be used as a ground adulticide, ground larvicide in pastures and as an air larvicide in pastures to control mosquitos. Ground adulticiding use will be done with the Hudson Back Pack low volume sprayer.

Ground larviciding use will be done with the Hudson Back Pack low volume sprayer only.

DOSAGE/APPLICATION RATES:

In ground adulticide treatments, to be applied at the uniform rate of 8.4 fl. oz. of concentrated material per acre (0.34 AI) (Hudson)

In ground larvicide treatments, to be applied at the uniform rate of 12.5 fl. oz. of concentrated material per acre (0.5 AI) (Hudson)

Air larvicide treatments will be applied at the uniform rate of 13.0 fl. oz. of concentrated material per acre (0.5 AI)

LIMITATIONS

Limited to pasture sites only as an air larvicide. Limited to rural sites only as a ground adulticide.

SAFETY PRECAUTIONS

Apron, goggles, gloves and boots shall be worn by employees loading the helicopter. County foremen shall load the helicopters.

Respirator and gloves shall be worn by employees using and loading the Hudson Back Pack.

Material shall be transported on vehicles in 5 gallon white jugs or drums with covers securely sealed and containers securely stored in truck bed to prevent spillage.

Material spills in vehicle or in the shop shall be neutralized with soda ash immediately.

Do not walk on spilled material.

Avoid skin or clothing contact with this material; if contaminated, wash the contaminated part of body with soap and water and change contaminated clothing immediately.

MATERIAL CODE 5-6-9-10 RESMETHRIN LIQUID

FORMULATIONS/USES:

May be used as a ground adulticide to control mosquito adults.

Ground adulticiding will be accomplished with non-thermal aerosol generator (cold fog machines).

DOSAGE/APPLICATION RATES:

In ground adulticide treatments, to be applied at the uniform rate of 1.5 fl. oz. of finished spray material per acre with the non-thermal aerosal generators and 8.1 fl. oz. of finished spray material per acre with the Hudson Back Pack. The finished spray mixing rates for the non-thermal aerosol generator will be as follows--Material Code 10 will be mixed at 11.5 fl. oz. of 40% Resmethrin liquid concentrate added to 116.5 fl. oz. of mineral oil to yield 1 gallon finished spray material 0.0035 AI).

Material Code 5 will be mixed at 25.6 oz. of 18.5% Resmethrin Liq. concentrate added to 102.5 fl. oz. of mineral oil to yield 1 gal. finished spray material (0.0035 AI).

The finished spray mixing rate for the Hudson Back Pack will be as follows--Material Code 9 will be mixed at 4.3 fl. oz. of 40% Resmethrin liquid concentrate into 123.7 fl. oz. of mineral oil to yield 1 gallon finished spray material (0.007 AI).

Material Code 6 will be mixed at 9.3 fl. oz. of 18.5 % resmethrin liquid concentrate added to 118.7 fl. oz. mineral oil to yield 1 gal. finished spray material (0.007 AI)

LIMITATIONS:

Limited to non-thermal aerosol generator and Hudson Back Pack treatments only.

SAFETY PRECAUTIONS:

Gloves and boots shall be worn by employees while filling insecticide tanks on equipment. No protective gear is required while applying material from the vehicle. The insecticide supply valve will be shut off before leaving vehicle cab to inspect, stop, or start machine.

Avoid repeated driving of vehicle thru insecticide fog. Material will be transported on vehicles in 5 gallon white jugs or tanks provided with cold fog machines with covers securely sealed and containers securely fastened in truck bed to prevent spillage.

Material spills in the vehicle or in the shop shall be neutralized with soda ash immediately.

Do not walk on spilled materials.

Avoid skin or clothing contact with this material; if contaminated wash the contaminated part of body with soap and water immediately and change contaminated clothing.

MATERIAL CODE 7 PYRETHRUM LIQUID

FORMULATIONS/USES:

May be used to control mosquito adults by ground.

Ground adulticiding will be accomplished with the non-thermal aerosol generators (cold fog machines).

DOSAGE/APPLICATION RATES:

In ground adulticide treatments, to be applied at the uniform rate of 1.5 fl. oz. of finished spray material per acre. The finished spray mixing rate will be 43.6 fl. oz. Pyrethrum liquid concentrate added to 84.4 fl. oz. mineral oil to yield 1 gallon finished spray material. (0.004 AI)

LIMITATIONS:

Limited to non-thermal aerosol generator treatments only.

SAFETY PRECAUTIONS:

Gloves and boots shall be worn by employees while filling insecticide tanks on equipment. No protective gear is required while applying

material from vehicle. The insecticide supply valve will be shut off before leaving vehicle cab to inspect, stop, or start machine. Avoid repeated driving thru insecticide fog. Material will be transported in truck bed in 5 gallon white jugs or tanks provided with cold fog machines with covers securely sealed and containers securely fastened in truck bed to prevent spillage.

Material spills in the vehicle or in the shop shall be neutralized with soda ash immediately.

Do not walk on spilled material.

Avoid skin or clothing contact with this material; if contaminated wash material from contaminated part of body with soap and water immediately and change contaminated clothing.

DECONTAMINATION OF INSECTICIDE CONTAINERS

I. 30 AND 55 GALLON DRUMS

Empty drums contaminated with residual concentrates of all our insecticides, and finish spray dilutions of Dursban, MUST be decontaminated before re-use or shipment.

Resmethrin or Pyrethrum concentrate drums should be rinsed with solvent before re-use. The solvent containing Resmethrin or Pyrethrum may then be used in formulating a finished spray dilution.

Containers for Abate finish spray dilutions may also be handled in the above manner.

Drums containing Malathion, Abate or Dursban concentrates and Dursban finish spray dilutions must be decontaminated by filling with water and one half cup of Tri-Sodium Phosphate Detergent. This mixture should be allowed to stand overnight, then siphoned, pumped or dumped down a floor drain. NOTE: DO NOT use a barrel pump which is used for insecticides. Residue from the detergent will break down the insecticide which passes thru the pump.

If containers are to be re-used, rinse again with water or solvent to remove any detergent.

If containers are to be shipped or handled by persons not employed by the M.M.C.D., they must be decontaminated, inside and out with detergent, as the method above describes. This refers to all liquid insecticides, concentrates and finish spray dilutions.

II. 5 GALLON CONTAINERS AND 1 GALLON CONTAINERS

Methods used for the 30 and 55 gallon drums also apply to 5 gallon containers and their respective contents. When the decontamination is complete, punch holes in the 5 and 1 gallon containers and dispose of them in the approved manner.

III. SAFETY APPAREL

When decontaminating a 5 gallon, 30 gallon or 55 gallon container of a certain insecticide, use the same safety equipment required for mixing that insecticide.

July 16, 1976

TO: Employees

SUBJECT: UPDATE ON MATERIAL CODE NUMBERS AND FORMULATION CHANGES

I. Material Code #3

A. 5 lb. Malathion used as a larvicide in pasture sites only.

B. Rate of application 12.5 fl. oz. per acre.

C. Equipment - Hudson back pack sprayer NOTE: This rate of application can only be obtained with the use of the nozzle provided for pasture use.

D. Record this material on the FF-2 using Material Code #3. The amount used must be recorded in ounces.

II. Material Code #7

A. Pyrethrum used as an adulticide.

B. Rate of application 1.5 fl. oz. per acre.

C. Equipment--cold fog or leco.

D. Record this material on the FF-2 using Material Code #7. The amount of finished spray material used must be recorded in ounces.

E. Mixture rate--43.6 fl. oz. per gallon of finished spray.

III. Material Code #10

A. Resmethrin used as an adulticide.

B. Rate of application 1.5 fl. oz. per acre.

C. Equipment--cold fog or leco.

D. Record this material on the FF-2 using Material Code #10. The amount of finished spray material used must be recorded in ounces.

E. Mixture rate--11.5 fl. oz. per gallon of finished spray material.

IV. Material Code #11

A. 5 lb. Malathion used as an adulticide in rural areas only.

B. Rate of application 3.0 fl. oz. per acre.

C. Equipment - cold fog (designated machine only).

D. Record this material on the FF-2 using Material Code #11. The amount of material used must be recorded in ounces.

V. Material Code #14

A. Dursban 1% on Celatom Granules in special cases to be used as a ground residual or pre-hatch treatment. Use only as directed in place of sand granules.

B. Rate of application--residual treatment 5 lb. per acre.

C. Equipment--seeder.

D. Record this material on the FF-2 using Material Code #14. The amount of material used must be recorded in pounds.

When these materials are recorded in our bookkeeping systems use the blank spaces with the numbers that match the material code numbers.

When these material are recorded on the total material used section of the month end report use the following system:

A. 5 lb. Malathion - Code 3 and 11 - add with 5 lb. Malathion - Code 8 and 19

B. Pyrethrum - no change

C. Resmethrin - Code 10 - add with Resmethrin - Code 5, 6 and 9

D. Dursban 1% - Code 14 - add with Dursban 1% Code 25 and 26.

If you have any questions regarding these changes please ask your Foreman or Supervisor or call the Main Office.

SOURCE: M.M.C.D. Records, 1976

July 20, 1976

TO: SUPERVISORS AND FOREMEN

SUBJECT: MIXING INSTRUCTIONS FOR THE ADDITION OF TOLUOL TO THE 40% RESMETHRIN SOLUTIONS

A. Hudson Back Pack (Material Code #9)

1.85 gal.	Resmethrin 40%
1.35 gal.	Hysol
.50 gal.	Toluol
51.30 gal.	Klearol
55.00 gal.	finished spray material

B. Cold Fog

5.00 gal.	Resmethrin 40% (Material Code #10)
3.75 gal.	Hysol
1.25 gal.	Toluol
45.00 gal.	Klearol
55.00 gal.	finished spray material

These new mixture rates do not change our material codes being used in the bookkeeping system.

SOURCE: M.M.C.D. Records, 1976

TO: COUNTY SUPERVISORS

SUBJECT: MODIFICATION OF BOOKKEEPING SYSTEM

For application of 5 lb. Malathion in pasture sites we will be using Material Code Number 3. When recording the material use the blank space with the number 3 on the Weekly Ground Insecticide Use Report and the Monthly Inspection, Treatment and Insecticide Use Report. When you total the amount used for the month in the Total Material Used Section add this material in the column marked 8-19. This procedure will give us the total amount used (according to the FF-2's) in your County for the month.

For application of Dursban 1% on Celatom Granules to ground sites we will be using Material Code Number 14. When recording the material use the blank space with the Number 14 on the Weekly Ground Insecticide Use Report and the Monthly Inspection, Treatment and Insecticide Use Report. When you total the amount used for the month in the total material used section add this material in the column marked 25-26. This procedure will give us the total amount used (according to the FF-2's) in your county for the month.

SOURCE: M.M.C.D. Records, 1976

May 25, 1976

TO: COUNTY SUPERVISORS

SUBJECT: NEW MIXTURE RATE FOR 40% RESMETHRIN

When mixing finished spray material for the cold fog machines in 55 gallon drums draw out 10 gallons of diluent and add 5 gallons of solvent and 5 gallons of 40% Resmethrin concentrate. Blend this material for 5 minutes with a liquid agitator. (Mix solvent and insecticide well then add to oil).

The cold fog machines will apply this material at 9.0 oz. per minute with the vehicle traveling at 10 mph. At this rate of application we will be applying the finished spray material at a rate of 1.5 oz. per acre (.0035 AI).

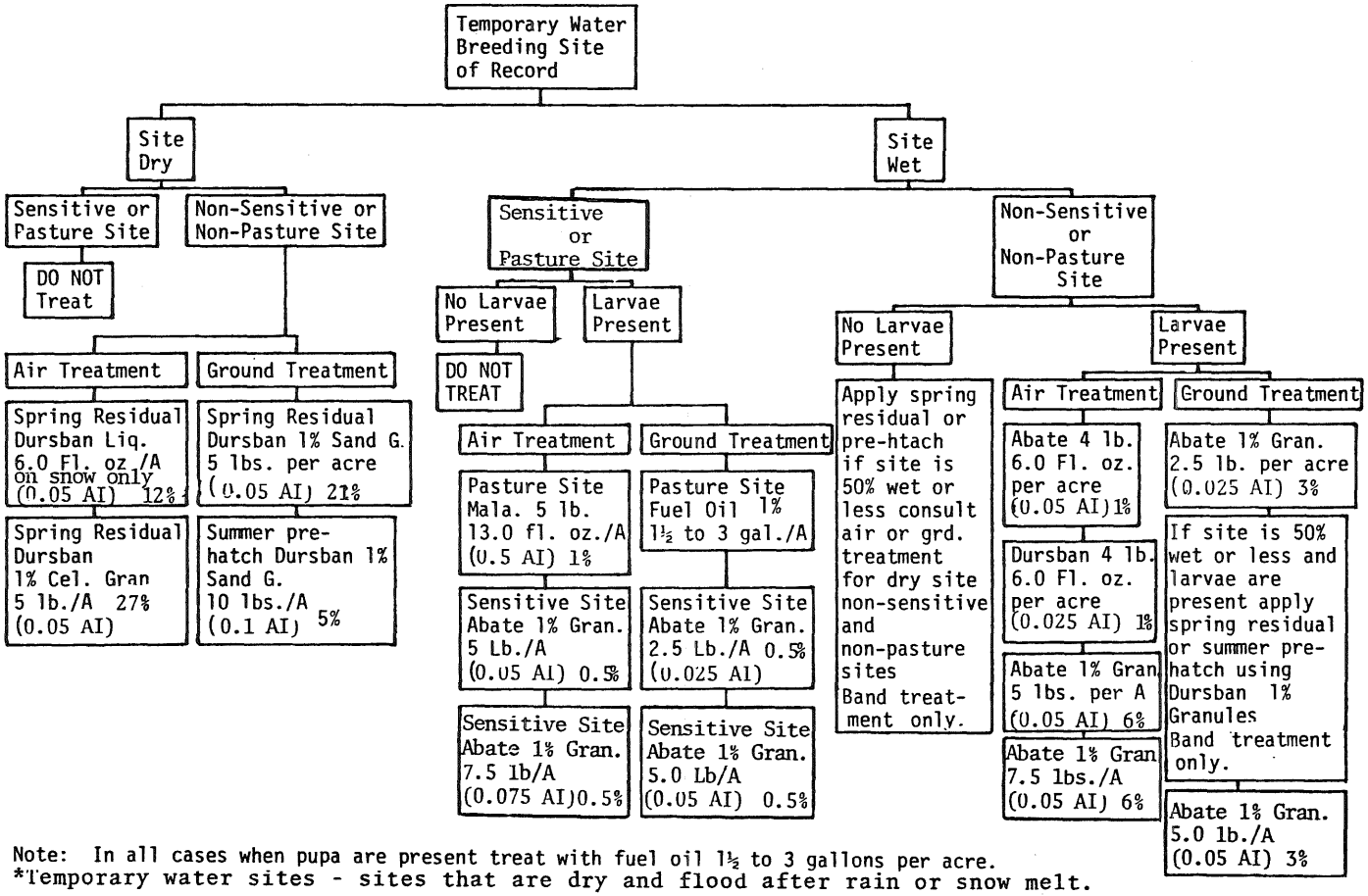
Bookkeeping System Modification: For application of this 40% Resmethrin formulation we will be using material code number 10. When recording the material use the blank space with the number 10 on the Weekly Ground Insecticide Use Report and the Monthly Inspection, Treatment and Insecticide Use Report. When you total the amount used for the month in the total material used section add this material in the column marked 5,6, and 9. This procedure will give us the total amount used (according to FF-2's) in your County for the month.

To adjust gallons of finished spray material to gallons of 40% Resmethrin multiply the gallons of finished spray material by 11.5 and divide by 128 to find the amount of 40% Resmethrin used.

SOURCE: M.M.C.D. Records, 1976

METROPOLITAN MOSQUITO CONTROL DISTRICT

GUIDLINES FOR LARVAL MOSQUITO CONTROL MEASURES FOR *TEMPORARY WATER SITES
61,000 Acres Treated Annually (90% of all Acres Treated)

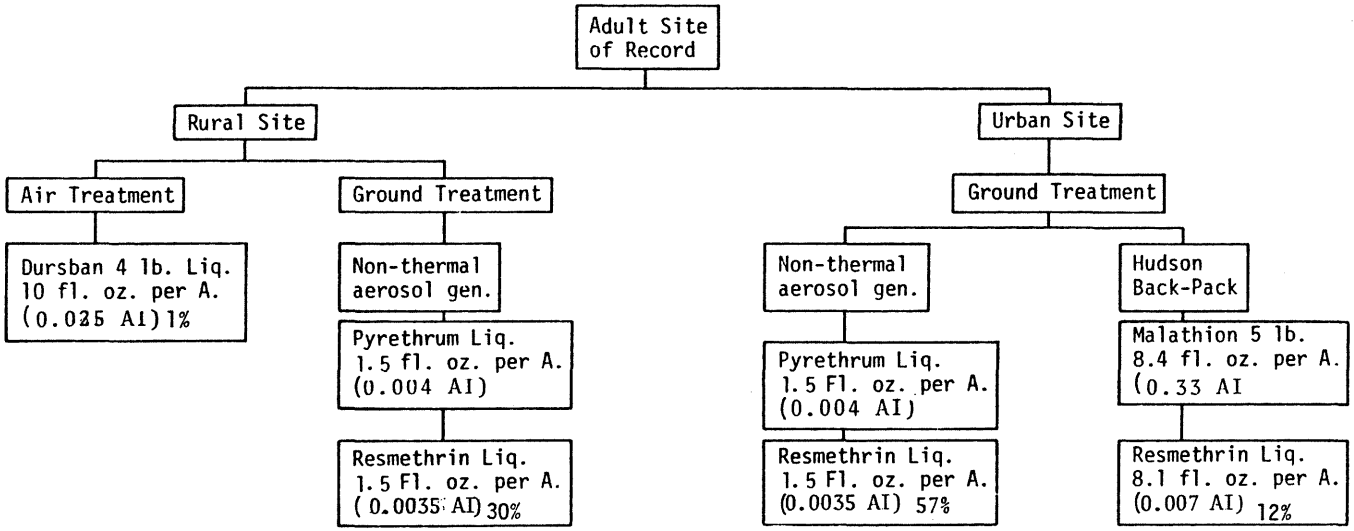


Note: In all cases when pupa are present treat with fuel oil 1½ to 3 gallons per acre.
*Temporary water sites - sites that are dry and flood after rain or snow melt.

METROPOLITAN MOSQUITO CONTROL DISTRICT

GUIDLINES FOR ADULT MOSQUITO CONTROL MEASURES

233,932 Acres Treated Annually



(1% Aerial Treatment, 99% Ground Treatment)
Air treatment with Dursban 4 lb. liquid at 0.025AI requires prior approval of the Director.

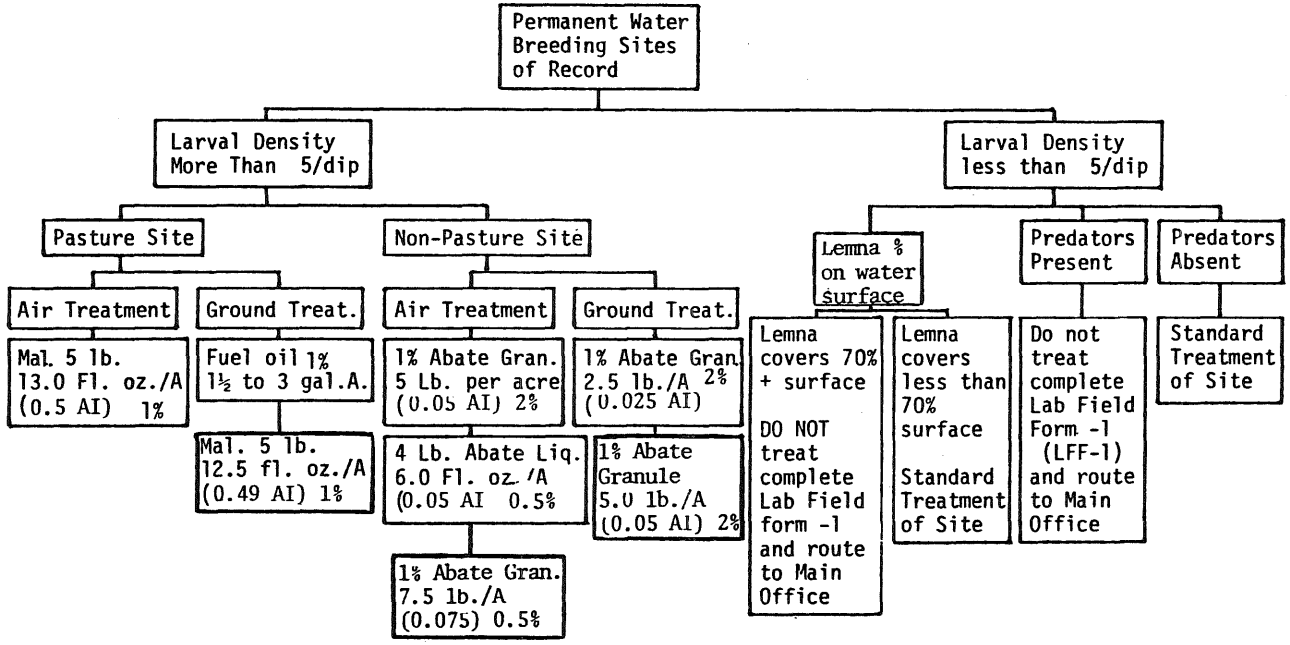
Note: Bite collection must be 5 in 5 minutes or more before treatment of site.

Non-thermal aerosol generators are to be used only under proper weather conditions.

METROPOLITAN MOSQUITO CONTROL DISTRICT

GUIDLINES FOR LARVAL MOSQUITO CONTROL MEASURES FOR *PERMANENT WATER SITES

7,000 Acres Treated Annually (10% of all Treated Acres)



*Permanent water sites are wet 1 month or longer.

NOTE: Do not apply Fuel Oil for pupal control in non-pasture sites.

GROUP 1 GROUND LARVICIDING

FUEL OIL MIXED WITH TRITON X-100 SPREADER

Size of Area to be Treated (Acres)	1 1/2 Gal. Per Acre Gallons To Use	2 Gal. Per Acre Gallons To Use	3 Gal. Per Acre Gallons To Use
0.1	0.2	0.2	0.3
0.2	0.3	0.4	0.6
0.3	0.5	0.6	0.9
0.4	0.6	0.8	1.2
0.5	0.8	1.0	1.5
0.6	0.9	1.2	1.8
0.7	1.0	1.4	2.1
0.8	1.2	1.6	2.4
0.9	1.4	1.8	2.7
1.0	1.5	2.0	3.0

Spreader shall be mixed with the Fuel Oil at the rate specified by your Foreman.

NOTE: Always record the actual amount of material used in treating a site.

SOURCE: M.M.C.D. Field Manual

exhibit d.

PERSONNEL

Each county unit operates with a supervisor overseeing the work of four foremen. Each foreman works in a designated area of his county and has four or five seasonal employees working for him.

A new seasonal employee is screened for previous experience in similar work, driving habits, and common sense. When hired, the new employee becomes a trainee for approximately 30 calendar days.

During this period he/she works with a foreman or an experienced seasonal employee and is taught mosquito control through first hand experience and utilization of the District's Field Operations Manual. The employee learns where and how to locate mosquito breeding areas through use of District maps. The employee learns to find mosquito larvae and to treat the breeding sites with the proper amounts of the needed material as necessary.

With his knowledge of District operations, records keeping equipment and maps, the employee is ready to be assigned independent work. From this point his work is frequently inspected by the foreman to maintain the quality of his work and to correct any problems.

Each spring procedures are reviewed with the returning employees in training sessions with their foremen and supervisors. Field Operations Manuals are issued to each employee for training and as a reference guide (see attached portions of Field Operations Manual for reference, pp. 5-8, pp. 10-13).

When a foreman's position becomes open, experienced seasonal personnel are screened as to their knowledge of the operation, educational background, leadership qualities and work records. The new foreman is familiar with the operations of the District but works closely with his supervisor. The foreman's job includes many of the insecticide application responsibilities of the seasonal worker, but has the added responsibilities of supervision. Between 25 and 75 percent of the foreman's work

involves coordinating subordinate work, field inspection of subordinate work for quality control and inspection of subordinate records keeping, equipment condition, etc.

Winter training sessions for supervisors and foremen include program changes, new developments in mosquito control, and lectures on mosquito biology, entomology and biological control. Discussions on insecticides and how they work and safety programs are also a part of the training. Each spring the permanent field employees of the District are tested by the Minnesota State Department of Agriculture to meet the requirements for becoming Certified Pesticide Applicators.

The District encourages employees to take independent courses which may help them in knowledge of their field, courses to improve their supervisory abilities, or special training such as first aid.

About half of the District's foremen are loaned to other county government departments during the winter months. Whenever possible, the employee learns a skill which may be useful to the District when the employee returns.

County supervisors are generally chosen from the ranks of the foremen undergoing similar or identical training procedures. The supervisor's responsibility is to coordinate the work in the county and inspect the work of his subordinates. He is responsible to the Director to communicate the state of his county and to keep lines open between his county and the rest of the District.

Two coordinating assistants work with the Director and the supervisors to coordinate assigned aspects of the field program and maintain overall quality control and District consistency.

PERSONNEL: POSITION RESPONSIBILITIES

POSITION: INSPECTOR

Duties and responsibilities:

Under supervision to-

1. Locate and treat mosquito breeding sites in accordance with District guidelines.

2. Locate and treat adult mosquito harboring sites as directed.

3. Maintain and clean District vehicles and equipment.

4. Perform related work as assigned (site modification, special studies, shop work, maintenance work, etc.)

Required knowledge, skills and abilities:

1. Ability to receive and carry out oral and written directions.

2. Basic understanding of arithmetic and ability to make simple computations.

3. Some mechanical aptitude.

4. Good physical condition.

5. Ability to operate and maintain a motor vehicle.

6. Ability to adapt to M.M.C.D. rules and operating procedures.

7. Knowledge of mosquito control techniques.

Examples of work performed:

1. Use of District field maps to locate mosquito larval and adult sites.

2. Inspect aquatic breeding sites with a white enamel dipper for presence of mosquito larvae, differentiate mosquito larvae from other aquatic larvae, collect and preserve larvae for identification in the laboratory.

3. Inspect adult mosquito sites and take bite collections of adult mosquitos for laboratory identification.

4. Measure out proper amounts of insecticide and make application with sprayer, seeder, cold fogger or back-pack to mosquito breeding and adult sites, make measurements to determine acreage of a site, to re-inspect sites to determine level of mosquito control achieved.

5. Record all larval and adult findings and insecticide applications on field forms.

6. Load granule insecticides into helicopters. Foremen only will load helicopters with ULV concentrates.

7. Make adjustments and minor repairs to sprayers, seeders, and back-packs. Foremen and Supervisors only will adjust or repair cold foggers.

8. Operate and be responsible for the care of a District vehicle including maintenance of vehicle records.

9. Make applications of mosquito larval predators to breeding sites.

10. Under supervision to work on source reduction projects.

11. Assist Foreman with column sampling program.

12. Communicate frequently with Foreman reporting problems, suggestions and work progress as required.

13. Perform necessary work in and around the County Headquarters.

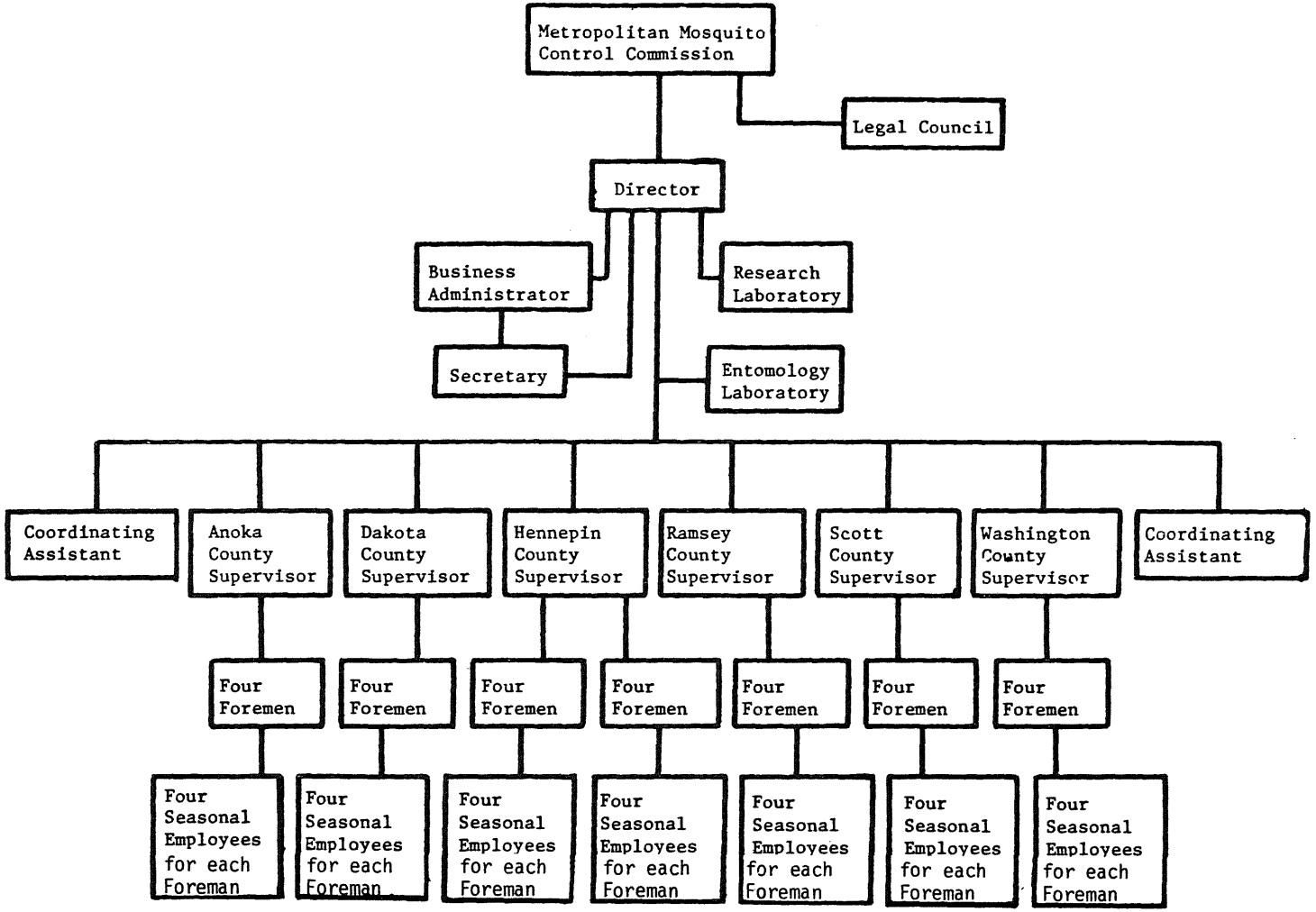
14. Assist in the training of new seasonal employees.

Required qualifications:

1. High school diploma or G.E.D. certificate.

2. Valid Minnesota Driver's License required.

3. Minimum age requirement - 18 years before August 31 of the current session.


Metropolitan Mosquito Control Commission
Legal Council
Director
Business Administrator
Research Laboratory
Secretary
Entomology Laboratory
Coordinating Assistant
Anoka County Supervisor
Dakota County Supervisor
Hennepin County Supervisor
Ramsey County Supervisor
Scott County Supervisor
Washington County Supervisor
Coordinating Assistant
Four Foremen
Four Foremen
Four Foremen
Four Foremen
Four Foremen
Four Foremen
Four Foremen
Four Seasonal Employees for each Foreman
Four Seasonal Employees for each Foreman
Four Seasonal Employees for each Foreman
Four Seasonal Employees for each Foreman
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Four Seasonal Employees for each Foreman
Four Seasonal Employees for each Foreman

INSPECTION AND TREATMENT PROCEDURE

I. Section maps and cards.

A. The Metropolitan Mosquito Control District maintains up to date section maps for each control division. These maps are used by seasonal employees to locate mosquito breeding and adult harboring sites.

B. Breeding sites are normally outlined in red and have a sequential number within that section assigned to them.

C. Adult harboring sites are wooded areas which have a letter assigned to them.

D. Information on the site is recorded on the section card (FF-4) which follows the section map.

Information on the section card.

1. Site number or letter.

2. Size in acres or tenths of acres.

3. Type of site (temporary water permanent water, etc.)

4. Other pertinent information pasture or sensitive site, etc.

E. Information on the inspection and treatment of a site will be recorded in the space provided for this information next to the information.

Information to be recorded.

1. Date.

2. Percent of the site that is wet.

3. Larvae or pupa per dip or number of adults collected in 5 minutes.

4. Employee number.

5. A column to check when the site is treated

II. Inspecting and treating mosquito breeding sites for larvae and or pupa.

A. Equipment and materials needed.

1. White enamel dipper.

2. Sample bottles.

3. Eye dropper.

4. Bottle labels.

5. 50% alcohol solution.

6. Boots.

7. Application equipment and control materials.

B. Procedure for inspecting and treating sites.

1. Find the site on the section map.

2. Locate the site in the section.

3. Read the information on the site found on the section card.

4. Using the white enamel dipper check for the presence of mosquito larvae or pupa. (Note - see section on mosquito larvae and pupa in this manual)

a. When larval densities are above 5/dip (5 to 10 dips per site are adequate) treat the site.

b. When the number per dip is less than 5, more dip samples should be taken to accurately determine the population levels, particularly when a decision is needed on whether to treat an air site.

c. Put no more than 10 of the collected larvae (no pupa) into the sample bottle, add enough 50% alcohol solution to preserve them, fill out and affix the bottle label, and send the sample to the laboratory for identification.

5. Refer to "Guidelines for larval mosquito control measures for permanent water sites" and "Guidelines for larval mosquito control for temporary water sites" to determine the proper treatment procedure for a site.

6. Record findings and treatment on the Section Card and Daily Inspection and Treatment Report.

III. Inspecting and Treating Adult Mosquito Harboring Sites

A. Equipment and material needed.

1. Killing tube or aspirator.

2. Sample boxes.

3. Box labels.

4. Application equipment and control materials.

B. Procedure for inspecting and treating sites.

1. Find the site on the section map.

2. Locate the site in the section.

3. Read the information on the site found on the section card.

4. Using the killing tube or the aspirator, trap mosquito adults that land on you.

a. Take this sample for a period of 5 minutes.

b. The bite collection must be 5 adult mosquitos or more in 5 minutes before the site can be treated.

c. Put the adult sample collected into the sample box, fill out and affix the box label and send the sample to the laboratory for identification.

5. Refer to "Guidelines for adult mosquito control measures" to determine the proper treatment procedure for a site.

6. Record findings and treatment on the Section Card and Daily Inspection and Treatment Report.

SOURCE: M.M.C.D. Field Manual

1974 VEHICLE LIST

1	1974 Ford Torino	302 V8 auto
1	1974 Ford Station Wagon	351 V8 auto
5	1973 Ford Station Wagon	351 V8 auto
1	1971 Ford Station Wagon	351 V8 auto
3	1972 Ford 1/2 ton PU	302 V8 auto
7	1974 Ford 1/2 ton PU	302 V8 auto
2	1970 Ford 3/4 ton PU	360 V8 auto
5	1971 Chev. 1/2 ton PU	307 V8 auto
3	1969 Ford 3/4 ton PU	360 V8 auto
3	1973 Int'l 1/2 ton PU	304 V8 auto
2	1970 Chev. 1/2 ton PU	307 V8 auto
2	1968 Int'l 3/4 ton PU	400 V8 Std. Trans.
1	1951 Chev. Oil Tank Truck	160 Std. 6
1	1957 Chev. Oil Tank Truck	160 Std. 6
55	1974 Int'l 1/2 ton PU	400 CI auto V8
92		
-2	oil trucks rarely used	
90	vehicles used regularly or semi regularly*	

*Semi regularly: everyday during mosquito season
regularly: not deadlined during winter months

SOURCE: M.M.C.D. Records

1975 VEHICLE LIST

1	1974 Ford Torino	302 Auto V8
1	1974 Ford Station Wagon	351 Auto V8
1	1975 Dodge 3/4 ton PU	360 V8 Auto 1/2 year
5	1973 Ford Station Wagon	351 Auto V8
1	1971 Ford Station Wagon	351 Auto V8
5	1975 Dodge 1/2 ton PU	225 Std. 6
3	1972 Ford 1/2 ton PU	302 Auto V8
7	1974 Ford 1/2 ton PU	302 Auto V8
2	1970 Ford 3/4 ton PU	360 Auto V8
5	1971 Chev. 1/2 ton PU	307 Auto V8
3	1969 Ford 3/4 ton PU	360 Auto V8
3	1973 Int'l 1/2 ton PU	304 Auto V8
2	1975 Int'l Scout II	304 Auto V8
1	1970 Chev. 1/2 ton PU	307 Auto V8
1	1975 Dodge 1/2 ton PU	318 Std. V8
1	1951 Chev. oil Tank Truck	160 Std. 6
1	1957 Chev. oil Tank Truck	160 Std. 6
40	1975 Int'l 1/2 ton PU	304 Auto V8
83		
-2	oil trucks	
81	in regular or semi regular use	

1976 VEHICLE LIST

1	1974 Ford Torino	302 Auto V8
1	1974 Ford Station Wagon	351 Auto V8
1	1975 Dodge 3/4 ton PU	360 Auto V8
5	1973 Ford Station Wagon	351 Auto V8
1	1971 Ford Station Wagon	351 Auto V8 1/2 yr.
1	1976 Chev. Chevelle	350 Auto V8 1/2 yr.
5	1975 Dodge 1/2 ton PU	225 Auto
3	1972 Ford 1/2 ton PU	302 Auto V8
7	1974 Ford 1/2 ton PU	302 Auto V8
2	1970 Ford 3/4 ton PU	360 Auto V8
4	1971 Chev. 1/2 ton PU	307 Auto V8
6	1976 Dodge 1/2 ton PU	225 Auto
3	1969 Ford 3/4 ton PU	360 Auto V8
3	1973 International 1/2 ton PU	304 Auto V8
2	1975 Int'l Scout II	304 Auto V8
1	1970 Chev. 1/2 ton PU	307 Auto V8
1	1975 Dodge 1/2 ton PU	318 Std. V8
1	1951 Chev. Oil Tank Truck	160 Std. 6
1	1957 Chev Oil Tank Truck	160 Std. 6
1	1950 Ford Tractor	
1	1952 Jeep	4 cyl. 1/2 yr.
34	1976 Chev. 1/2 ton PU	350 V8 Auto
80	vehicles	
-5	(2 oil trucks, tractor, jeep, station wagon)	
75	in regular or semi regular use	

PSEUDOCHOLINESTERASE MONITORING

The primary reason for monitoring the enzymes of the pseudocholinesterase family in people handling organic thiophosphate insecticides is to detect early toxicity due to these chemicals. The pseudocholinesterase (PChE) enzymes are synthesized in the liver and released into the blood. Therefore, all people have a certain normal concentration of this enzyme in their serum which can be measured by chemical methods. If an individual incurs toxic damage due to insecticides a marked decrease (up to 40 percent) of his PChE concentration results.

The protocol for monitoring people involved with handling insecticides is as follows:

1. The PChE concentration in each individual is determined before their exposure to the insecticides so to establish a baseline level.

2. If an individual is suspected of toxicity another PChE level is measured and compared with his own baseline value. If the new value is significantly lower, there is evidence of chemical toxicity.

The blood is drawn at Metropolitan Medical Center because of its central location and, more importantly, so that the integrity of the sample can be protected. The blood is allowed to clot and the serum used for PChE testing. The pseudocholinesterases are performed with a kinetic spectrophotometer at a wavelength of 405 nanometers. The substrate used is acetylthiocholine which is hydrolyzed to acetate and thiocholine. The production of thiocholine is monitored by reacting it with dithiobisnitrobenzoic acid and measuring the thionitrobenzoic acid color change. The reagents are supplied by Boehringer Mannheim Corporation and the method is adapted from the work of G. L. Ellman et al., (1961).

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DGH/dn

METROPOLITAN MOSQUITO CONTROL DISTRICT PROGRAM SAFETY FACTORS

AERIAL INSECTICIDE APPLICATION

Helicopters are used for aerial application in lieu of fixed wing aircraft due to their greater maneuverability in conjested urban air space, easier ground to air guidance and reloading.

One percent Abate and one percent chlorpyrifos granules are used in urban aerial applications. Granular formulations can generally be applied in winds up to ten mph without drifting beyond the target area. Granules fall thru the vegetation, without leaving residues, and do not release the insecticide until contact with water.

Conversely, less expensive ultra-low-volume liquid applications are susceptible to drifting off target, leave residues on vegetation, and can be toxic to flying insects. Low volume materials also require greater care in mixing and loading the helicopter.

Ultra-low-volume aerial applications are made during spring months in rural open areas if the vegetation does not restrict penetration. Liquid applications are made only in the early morning or evening when winds are below 4 mph. The cost of ultra-low-volume applications are less than half the cost of granule applications. Workers which load helicopters with granules are required to wear aprons, chemical resistant gloves, and approved respirators. Goggles and rubber boots are added when loading liquid materials.

GROUND APPLICATIONS - LARVICIDE PRE-HATCH

Abate 1% and chlorpyrifos 1% granules are used almost exclusively for ground larviciding or pre-hatch. Abate is not registered for food animal pastures so #2 fuel oil and low volume liquid 5 lb. malathion treatments are used in pastures for larviciding. Fuel oil is also used as a pupacide. The use of the insect growth regulator Altosid in pasture sites is limited due to cost.

Granular formulations are used because of their ease in handling and storage. There is a reduced exposure hazard associated with granules v s liquid application, e.g., the chemical does not release from the granule during application whereas a change of wind direction while applying liquid could contaminate an applicator. Residues on vegetation are also avoided by the use of granules. Off target treatment is very unlikely with ground equipment. If it does occur, the granules slowly release the insecticide upon contact with rain, dew etc., and the insecticide leaches into the soil and breaks down.

Pesticide applicators are requiqed to wear rubber boots, aprons, chemical resistant gloves and NIOSH approved pesticide respirators.

GROUND ADULTICIDING

Approximately 95% of the acreage treated for adult mosquito control is done with truck mounted ULV cold fog machines. The remaining 5% consists of spot treatments completed with Hudson low volume back-pack machines. The major insecticide is the pyrethroid, Resmethrin mixed with Klearol, a food grade mineral oil. Malathion is used in some rural treatments away from houses and cars. Cold fog treatments are limited to evening hours when conditions are most favorable for adult control. Due to the small particle size of the cold fog, little residue is left on foliage, thus the evening treatments are less harmful to non-target beneficial insects most of which do not fly during this period and are not contacted by the aerosol particles. Rubber boots, aprons, and gloves are required when loading material into the cold fog machines. No protective gear is required when treating from inside the vehicle. These units are equipped with insecticide supply valves which are turned on and off from within the vehicle.

Gloves, boots, a respirator and an apron are required for loading and treating with the Hudson Back-Pack.

MIXING LIQUID MATERIALS

Liquid treatments are a small part of the District's operation but great care is taken in mixing these materials with diluents when they are needed. Full protective gear--respirator, apron, goggles, gloves and boots are required for mixing. Permanent personnel, supervisors or foremen who are familiar with the safety procedures, are the only people authorized to mix insecticides.

To insure that application rates, and procedures are followed, foremen spend much of their time checking back on subordinate work. Our record keeping system provides a two way check on insecticide treatments. A weekly inventory of insecticides used is compared to the records of what was required for assigned acreage treated. If discrepancies appear they are checked out, the reasons for the discrepancy understood and corrected.

Pre and post employee blood cholinesterase levels are monitored to insure that the employee exposure levels are within safe limits.

SOURCE: M.M.C.D. Field Manual

exhibit e.

STANDARDS FOR CERTIFICATION OF PESTICIDE APPLICATORS

SECTION 171.1 GENERAL

This section deals with the certification of applicators of restricted use pesticides.

SECTION 171.2 DEFINITIONS

Terms used in this subpart shall have the meanings set forth for such terms in the Act. In addition, as used in this subpart, the following terms shall have the meanings stated below:

(a) The term "accident" means an unexpected, undesirable event, caused by the use or presence of a pesticide, that adversely affects man or the environment.

(b) The term "Act" means the Federal Insecticide, Fungicide and Rodenticide Act, as amended (86 Stat. 973), and other legislation supplementary thereto and amendatory thereof.

(c) The term "Administrator" means the Administrator of the Environmental Protection Agency, or any office or employee of the Agency to whom authority has heretofore been delegated, or to whom authority may hereafter be delegated, to act in his stead.

(d) The term "Agency," unless otherwise specified, means the United States Environmental Protection Agency.

(e) The term "agricultural commodity" means any plant, or part thereof, or animal, or animal product, produced by a person (including farmers, ranchers, vineyardists, plant propagators, Christmas tree growers, aquaculturists, floriculturists, orchardists, foresters, or other comparable persons) primarily for sale, consumption, propagation, or other use by man or animals.

(f) The term "calibration of equipment" means measurement of dispersal or output of application

equipment and adjustment of such equipment to control the rate of dispersal, and droplet or particle size of a pesticide dispersed by the equipment.

(g) The term "certification" means the recognition by a certifying agency that a person is competent and thus authorized to use or supervise the use of restricted use pesticides.

(h) The term "certified applicator" means any individual who is certified to use or supervise the use of any restricted use pesticides covered by his certification.

(i) The term "commercial applicator" means a certified applicator (whether or not he is a private applicator with respect to some uses) who uses or supervises the use of any pesticide which is classified for restricted use for any purpose or on any property other than as provided by the definition of "private applicator."

(j) The term "compatibility" means that property of a pesticide which permits its use with other chemicals without undesirable results being caused by the combination.

(k) The term "competent" means properly qualified to perform functions associated with pesticide application, the degree of capability required being directly related to the nature of the activity and the associated responsibility.

(l) The term "common exposure route" means a likely way (oral, dermal, respiratory) by which a pesticide may reach and/or enter an organism.

(m) The term "environment" means water, air, land, and all plants and man and other animals living therein, and the interrelationships which exist among them.

(n) The term "forest" means a concentration of trees and related vegetation in non-urban areas sparsely inhabited by and infrequently used by humans; characterized by natural terrain and drainage patterns.

(o) The term "hazard" means a probability that a given pesticide will have an adverse effect on man

or the environment in a given situation, the relative likelihood of danger or ill effect being dependent on a number of interrelated factors present at any given time.

(p) The term "host" means any plant or animal on or in which another lives for nourishment, development, or protection.

(q) The term "non-target organism" means a plant or animal other than the one against which the pesticide is applied.

(r) The term "ornamental" means trees, shrubs, and other plantings in and around habitations generally, but not necessarily located in urban and suburban areas, including residences, parks, streets, retail outlets, industrial and institutional buildings.

(s) The term "practical knowledge" means the possession of pertinent facts and comprehension together with the ability to use them in dealing with specific problems and situations.

(t) The term "private applicator" means a certified applicator who uses or supervises the use of any pesticide which is classified for restricted use for purposes of producing any agricultural commodity on property owned or rented by him or his employer or (if applied without compensation other than trading of personal services between producers of agricultural commodities) on the property of another person.

(u) The term "protective equipment" means clothing or any other materials or devices that shield against unintended exposure to pesticides.

(v) The term "regulated pest" means a specific organism considered by a State or Federal agency to be a pest requiring regulatory restrictions, regulations, or control procedures in order to protect the host, man and/or his environment.

(w) The term "restricted use pesticide" means a pesticide that is classified for restricted use under the provisions of Section 3(d)(1)(C) of the Act.

(x) The term "standard" means the measure of knowledge and ability which must be demonstrated as a requirement for certification.

(y) The term "State" means a State, the District of Columbia, the Commonwealth of Puerto Rico, the Vigin Islands, Guam, the Trust Territory of the Pacific Islands, and American Samoa.

(z) The term "susceptibility" means the degree to which an organism is affected by a pesticide at a particular level of exposure.

(aa) The term "toxicity" means the property of a pesticide to cause any adverse physiological effects.

(bb) The term "under the direct supervision of" means the act or process whereby application of a pesticide is made by a competent person acting under the instructions and control of a certified applicator who is responsible for the actions of that person and who is available if and when needed, even though such certified applicator is not physically present at the time and place the pesticide is applied.

SECTION 171.3 CATEGORIZATION OF COMMERCIAL APPLICATORS OF PESTICIDES

(a) PROCEDURE

Categories of applicators (other than private) using or supervising the use of restricted use pesticides are identified below. State systems of applicator identification shall adopt these categories as needed, along with such appropriate subcategories as are necessary to meet the particular requirements of the State.

(b) CATEGORIES

(1) Agricultural Pest Control

(i) Plant

This category includes commercial applicators using or supervising the use of restricted use pesticides in production

of agricultural crops, including without limiting the foregoing, tobacco, peanuts, cotton, feed grains, soybeans and forage; vegetables; small fruits; tree fruits and nuts, as well as on grasslands and non-crop agricultural lands.

(ii) Animal

This category includes commercial applicators using or supervising the use of restricted use pesticides on animals, including without limiting the foregoing, beef cattle, dairy cattle, swine, sheep, horses, goats, poultry and livestock, and to places on or in which animals are confined.

Doctors of Veterinary Medicine engaged in the business of applying pesticides for hire, publicly holding themselves out as pesticide applicators, or engaged in large-scale use of pesticides are included in this category.

(2) Forest Pest Control

This category includes commercial applicators using or supervising the use of restricted use pesticides in forests, forest nurseries, and forest seed producing areas.

(3) Ornamental and Turf Pest Control

This category includes commercial applicators using or supervising the use of restricted use pesticides to control pests in the maintenance and production of ornamental trees, shrubs, flowers, and turf.

(4) Seed Treatment

This category includes commercial applicators using or supervising the use of restricted use pesticides on seeds.

(5) Aquatic Pest Control

This category includes commercial applicators using or supervising the use of any restricted use pesticide purposefully applied to standing or running water, excluding applicators engaged in public health related activities included in category 8 below.

(6) Right-of-Way Pest Control

This category includes commercial applicators using or supervising the use of restricted use pesticides in the maintenance of public roads, electric powerlines, pipelines, railway rights-of-way or other similar areas.

(7) Industrial, Institutional, Structural and Health Related Pest Control

This category includes commercial applicators using or supervising the use of restricted use pesticides in, on, or around food handling establishments, human dwellings, institutions, such as schools and hospitals, industrial establishments including warehouses and grain elevators, and any other structures and adjacent area, public or private; and for the protection of stored, processed, or manufactured products.

(8) Public Health Pest Control

This category includes State, Federal or other governmental employees using or supervising the use of restricted use pesticides in public health programs for the management and control of pests having medical and public health importance.

(9) Regulatory Pest Control

This category includes State, Federal or other governmental employees who use or supervise the use of restricted use pesticides in the control of regulated pests.

(10) Demonstration and Research Pest Control

This cateogry includes: (1) individuals who demonstrate to the public the proper use and techniques of application of restricted use pesticides or supervise such demonstration, and (2) persons conducting field research with pesticides, and in doing so, use or supervise the use of restricted use pesticides.

Included in the first group are such persons as extension specialists and county agents, commercial representatives demonstrating pesticide products, and those individuals demonstrating methods used in public programs.

The second group includes: State, Federal, commercial and other persons conducting field research on or utilizing restricted use pesticides.

(c) OTHER CATEGORIES AND SUBCATEGORIES

Any State submitting a plan pursuant to this section for the certification of applicators, as provided for below, may designate such subcategories within the above 10 categories as it deems necessary. In addition, a State may delete a category not needed or may request the Administrator's approval of additional major categories.

SECTION 171.4 STANDARDS FOR CERTIFICATION OF COMMERCIAL APPLICATORS

(a) DETERMINATION OF COMPETENCY

Competence in the use and handling of pesticides shall be determined on the basis of written examinations, and, as appropriate, performance testing, based upon standards set forth below and which are approved by the Administrator. Such examination and testing shall include the general standards applicable to all categories (Section 171.4(b)) and the additional standards specifically identified for each category or subcategory (if any) in which an applicator is to be classified (Section 171.4(c)). State standards must conform and be at least equal

to those prescribed herein. In developing the details of standards at the State level and in structuring examinations, it is important to recognize and reflect the extent of competency appropriate and necessary to a particular category.

(b) GENERAL STANDARDS FOR ALL CATEGORIES OF CERTIFIED APPLICATORS

(1) All commercial applicators shall demonstrate practical knowledge of the principles and practices of pest control and safe use of pesticides. Testing shall be based on examples of problems and situations appropriate to the particular category or subcategory of the applicator's certification and the following areas of competency:

(i) Label & Labeling Comprehension

(a) The general format and terminology of pesticide labels and labeling;

(b) The understanding of instructions, warnings, terms, symbols,and other information commonly appearing on pesticide labels;

(c) Classification of the product, general or restricted; and

(d) Necessity for use consistent with the label.

(ii) Safety--Factors including:

(a) Pesticide toxicity and hazard to man and common exposure routes;

(b) Common types and causes of pesticide accidents;

(c) Precautions necessary to guard against injury to applicators and other individuals in or near treated areas;

(d) Necessity for use consistent with the label.

(ii) Safety--Factors including:

(a) Pesticide toxicity and hazard to man and common exposure routes;

(b) Common types and causes of pesticide accidents;

(c) Precautions necessary to guard against injury to applicators and other individuals in or near treated areas;

(d) Need for and use of protective clothing and equipment;

(e) Symptoms of pesticide poisoning;

(f) First aid and other procedures to be followed in case of a pesticide accident; and

(g) Proper identification, storage, transport, handling, mixing procedures and disposal methods for pesticides and used pesticide containers, including precautions to be taken to prevent children from having access to pesticides and pesticide containers.

(iii) Environment--The potential environmental consequences of the use and misuse of pesticides as may be influenced by such factors as:

(a) Weather and other climatic conditions;

(b) Types of terrain, soil or other substrate;

(c) Presence of fish, wildlife and other non-target organisms; and

(d) Drainage patterns.

(iv) Pests--Factors such as:

(a) Common features of pest organisms and characteristics of damage needed for pest recognition;

(b) Recognition of relevant pests; and

(c) Pest development and biology as it may be relevant to problem identification and control.

(v) Pesticides--Factors such as:

(a) Types of pesticides;

(b) Types of formulations;

(c) Compatibility, synergism, persistence and animal and plant toxicity of the formulations;

(d) Hazards and residues associated with use;

(e) Factors which influence effectiveness or lead to such problems as resistance to pesticides; and

(f) Dilution procedures.

(vi) Equipment--Factors including:

(a) Types of equipment and advantages and limitations of each type; and

(b) Uses, maintenance and calibration.

(vii) Application Techniques--Factors including:

(a) Methods of procedure used to apply various formulations of pesticides, solutions, and gases, together with a knowledge of which technique of application to use in a given situation;

(b) Relationship of discharge and placement of pesticides to proper use,

unnecessary use, and misuse; and

(c) Prevention of drift and pesticide loss into the environment.

(viii) Laws and Regulations--Applicable State and Federal laws and regulations.

(c) SPECIFIC STANDARDS OF COMPETENCY FOR EACH CATEGORY OF COMMERCIAL APPLICATORS

Some of the factors referenced in (171.4(b)) are of particular importance because of the different types of activities carried out by applicators in each category. Such factors must be especially stressed and specifically reflected in State certification standards, as appropriate. For example, practical knowledge of drift problems should be required of agricultural applicators but not of seed treatment applicators. The latter, however, should be particularly knowledgeable of the hazards of the misuse of treated seed and the necessary precautionary techniques. Many applicators in categories 171.3(b) (8), (9), and (10) will have had considerable formal education, training and experience in preparation for their positions. Their competency with respect to the use and handling of pesticides will have been determined by examining boards of their professional scientific societies utilizing standards which equal or exceed those prescribed herein. Such standards should be consulted by States in developing their State standards for certification of such applicators under these regulations.

Commercial applicators in each category shall be particularly qualified with respect to the practical knowledge standards elaborated below:

(1) Agricultural Pest Control

(i) Plant

Applicators must demonstrate practical knowledge of the crops grown and the specific pests of those crops on which

they may be using restricted use pesticides. The importance of such competency is amplified by the extensive areas involved, the quantities of pesticides needed, and the ultimate use of many commodities as food and feed. Practical knowledge is required concerning soil and water problems, pre-harvest intervals, re-entry intervals, phytotoxicity, and potential for environmental contamination, non-target injury and community problems resulting from the use of restricted use pesticides in agricultural areas.

(ii) Animal

Applicators applying pesticides directly to animals must demonstrate practical knowledge of such animals and their associated pests. A practical knowledge is also required concerning specific pesticide toxicity and residue potential, since host animals will frequently be used for food. Further, the applicator must know the relative hazards associated with such factors as formulation, application techniques, age of animals, stress and extent of treatment.

(2) Forest Pest Control

Applicators shall demonstrate practical knowledge of the types of forests, forest nurseries, and seed production in their State and the pests involved. They should possess practical knowledge of the cyclic occurrence of certain pests and specific population dynamics as a basis for programming pesticide applications. A practical knowledge is required of the relative biotic agents and their vulnerability to the pesticides to be applied. Because forest stands may be large and frequently include natural aquatic habitats and harbor wildlife, the consequences of pesticide use may be difficult to assess. The applicator must therefore demonstrate practical knowledge of

control methods which will minimize the possibility of secondary problems such as unintended effects on wildlife. Proper use of specialized equipment must be demonstrated, especially as it may relate to meteorological factors and adjacent land use.

(3) Ornamental and Turf Pest Control

Applicators shall demonstrate practical knowledge of pesticide problems associated with the production and maintenance of ornamental trees, shrubs, plantings, and turf, including cognizance of potential phytotoxicity due to a wide variety of plant material, drift, and persistence beyond the intended period of pest control. Because of the frequent proximity of human habitations to application activities, applicators in this category must demonstrate practical knowledge of application methods which will minimize or prevent hazards to humans, pets, and other domestic animals.

(4) Seed Treatment

Applicators shall demonstrate practical knowledge of types of seeds that require chemical protection against pests and factors such as seed coloration, carriers, and surface active agents which influence pesticide binding and may affect germination. They must demonstrate practical knowledge of hazards associated with handling, sorting and mixing, and misuse of treated seed such as introduction of treated seed into food and feed channels, as well as proper disposal of unused treated seeds.

(5) Aquatic Pest Control

Applicators shall demonstrate practical knowledge of the secondary effects which can be caused by improper application rates, incorrect formulations, and faulty application of restricted use pesticides

used in this category. They shall demonstrate practical knowledge of various water use situations and the potential of downstream effects. Further, they must have practical knowledge concerning potential pesticide effects on plants, fish, birds, beneficial insects and other organisms which may be present in aquatic environments. These applicators shall demonstrate practical knowledge of the principles of limited area applicaton.

(6) Right-of-Way Pest Control

Applicators shall demonstrate practical knowledge of a wide variety of environments since rights-of-way can traverse many different terrains, including waterways. They shall demonstrate practical knowledge of problems on runoff, drift, and excessive foliage destruction and ability to recognize target organisms. They shall also demonstrate practical knowledge of the nature of herbicides and the need for containment of these pesticides within the right-of-way area, and the impact of their application activities in the adjacent areas and communities.

(7) Industrial, Institutional, Structural and Health Related Pest Control

Applicators must demonstrate a practical knowledge of a wide variety of pests including their life cycles, types of formulations appropriate for their control and methods of application that avoid contamination of food, damage and contamination of habitat and exposure of people and pets. Since human exposure, including babies, children, pregnant women, and elderly people, is frequently a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition, including continuous exposure in the various situations encountered in this category. Because health related pest control may

involve outdoor applications, applicators must also demonstrate practical knowledge of environmental conditions particularly related to this activity.

(8) Public Health Pest Control

Applicators shall demonstrate practical knowledge of vector-disease transmission as it relates to and influences application programs. A wide variety of pests is involved, and it is essential that they be known and recognized, and appropriate cycles and habitats be understood as a basis for control strategy. These applicators shall have practical knowledge of a great variety of environments ranging from streams to those conditions found in buildings. They should also have practical knowledge of the importance and employment of such non-chemical control methods as sanitation, waste disposal, and drainage.

(9) Regulatory Pest Control

Applicators shall demonstrate practical knowledge of regulated pests, applicable laws relating to quarantine and other regulation of pests, and the potential impact on the environment of restricted use pesticides used in suppression and eradication programs. They shall demonstrate knowledge of factors influencing introduction, spread, and population dynamics of relevant pests. Their knowledge shall extend beyond that required by their immediate duties since their services are frequently required in other areas of the country where emergency measures are invoked to control regulated pests, and where individual judgments must be made in new situations.

(10) Demonstration and Research Pest Control

Persons demonstrating the safe and effective use of pesticides to other applicators and the public will be expected to meet comprehensive standards reflecting a broad spectrum

of pesticide uses. Many different pest problem situations will be encountered in the course of activities associated with demonstration, and practical knowledge of problems, pests, and population levels occurring in each demonstration situation is required. Further, they should demonstrate an understanding of pesticide-organism interactions and the importance of integrating pesticide use with other control methods. In general, it would be expected that applicators doing demonstration pest control work possess a practical knowledge of all of the standards detailed in Section 171.4(b). In addition, they shall meet the specific standards required for categories (1) through (7) of this section as may be applicable to their particular activity.

Persons conducting field research or method improvement work with restricted use pesticides should be expected to know the general standards detailed in 171.4(b). In addition, they shall be expected to know the specific standards required for categories (1) through (9) of this section, applicable to their particular activity, or alternatively, to meet the more inclusive requirements listed under "Demonstration."

(d) SPECIAL STANDARDS--This space reserved for possible issuance of Special Standards.

(e) THE ABOVE STANDARDS DO NOT APPLY TO THE FOLLOWING PERSONS FOR PURPOSES OF THESE REGULATIONS:

(1) Persons conducting laboratory type research involving restricted use pesticides; and (2) Doctors of Medicine and Doctors of Veterinary Medicine applying pesticides as drugs or medication during the course of their normal practice.

SECTION 171.5 STANDARDS FOR CERTIFICATION OF PRIVATE APPLICATORS

(a) Competence in the use and handling of pesticides by a private applicator will be determined by procedures set forth below. State standards

must conform and be at least equal to those prescribed herein.

As a minimum requirement for certification, a private applicator must show that he possesses a practical knowledge of the pest problems and pest control practices associated with his agricultural operations, proper storage, use, handling and disposal of the pesticides and containers, and his related legal responsibility. This practical knowledge includes ability to:

(1) Recognize common pests to be controlled and damage caused by them.

(2) Read and understand the label and labeling information--including the common name of pesticide he applied; pest(s) to be controlled; timing and methods of application; safety precautions; any pre-harvest or re-entry restrictions; and any specific disposal procedures.

(3) Apply pesticides in accordance with label instructions and warnings, including the ability to prepare the proper concentration of pesticide to be used under particular circumstances taking into account such factors as area to be covered, speed at which application equipment will be driven, and the quantity dispersed in a given period of operation.

(4) Recognize local environmental situations that must be considered during application to avoid contamination.

(5) Recognize poisoning symptoms and procedures to follow in case of a pesticide accident.

(b) Such competence of each private applicator shall be verified by the responsible State agency through the administration of a private applicator certification system which

ensures that the private applicator is competent, based upon the standards set forth above, to use the restricted use pesticides under limitations of applicable State and Federal laws and regulations. A certification system shall employ a written or oral testing procedure, or such other equivalent system as may be approved as part of a State plan.

(1) In any case where a person, at the time of testing for certification, is unable to read a label, the responsible State agency may employ a testing procedure, previously approved by the Administrator, which can adequately assess the competence of such person with regard to all of the above standards. Certification must be related and limited to the use and handling of each individual pesticide for which he desires certification at any time. Therefore, the applicator will be authorized to use only the pesticide(s) for which he has demonstrated competence. A specific procedure is required for Section 171.5(a)(2) relating to label comprehension with testing designed to assure his knowledge of the following:

(i) Understanding of the label and labeling information including those items indicated in that subsection.

(ii) Sources of advice and guidance necessary for the safe and proper use of each pesticide related to his certification.

SECTION 171.6 STANDARDS FOR SUPERVISION OF NON-CERTIFIED APPLICATORS BY CERTIFIED PRIVATE AND COMMERCIAL APPLICATORS

Certified applicators whose activities indicate a supervisory role must demonstrate a practical knowledge of Federal and State supervisory requirements, including labeling, regarding the application of restricted use pesticides by non-certified applicators.

The availability of the certified applicator must be directly related to the hazard of the situation. In many situations, where the certified applicator is not required to be physically present, "direct supervision" shall include verifiable instruction to the competent person, as follows: (1) detailed guidance for applying the pesticide properly, and (2) provisions for contacting the certified applicator in the event he is needed. In other situations, and as required by the label, the actual physical presence of a certified applicator may be required when application is made by a non-certified applicator.

SOURCE: Reprint of Operations Division, Office of Pesticide Programs, U. S. Environmental Protection Agency, Washington, D. C. 20460.

From PROCEEDINGS OF THE NATIONAL CONFERENCE ON PROTECTIVE CLOTHING AND SAFETY EQUIPMENT FOR PESTICIDE WORKERS
Atlanta, Georgia, May 1-2, 1972, Federal Working Group on Pest Management, Washington, D.C., pp. 35-39, 1972

PROTECTION OF INDIVIDUALS WHO MIX OR APPLY PESTICIDES IN THE FIELD

by

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Workers who mix or apply pesticides in the field are often exposed to relatively high levels of such compounds. Illnesses do occur as a result of overexposure, however, most are a result of carelessness or accident. Experience has shown that if the various routes of entry of pesticides into the body are protected, even the more toxic compounds can be used safely.

There are four routes of entry: (1) dermal, (2) respiratory, (3) oral, and (4) through cuts or abrasions in the skin. Protection of these routes prevents exposure and prevention of exposure is good insurance against poisoning.

Dermal Route: This route is probably the most important route of entry into the body during most exposure situations in the field, especially where liquid sprays are involved. The dermal route has probably been responsible for many poisonings of workers, especially from the more toxic organophosphorus compounds.

In research studies at our laboratory we have measured the potential exposure of several hundred pesticide applicators, and the results indicate that over 97% of the pesticide to which the body is subjected during most exposure situations, and especially to applicators of liquid sprays, is deposited on the skin. It should be understood that any given amount of pesticide is more rapidly and more completely absorbed by the oral or respiratory routes. However, absorption of pesticides by these two routes is probably too small a fraction of the total potential exposure to be considered the main factor in most poisoning cases of workers in the field.

In one set of experiments, for example, we have calculated the potential dermal exposure of orchard spraymen to parathion to be approximately 19 mg/hr; however, the potential respiratory exposure was calculated to be only 0.02 mr/hr of exposure.[1] This indicates that there is potentially 950 times more dermal exposure than respiratory exposure to workers in that type of application operation. Thus, if only a small fraction of the potential dermal exposure was to be completely absorbed it would probably still be more than the respiratory exposure. The respiratory route, however, takes on increased importance when exposure is to vapors, fine dusts, fogs, or aerosols made up of very small droplets.

The importance of protecting specific body areas has not been clearly defined in the past due to the difficulty in accurately measuring the degree of absorption of different compounds through human skin. The most useful and probably most accurate estimations or measurements on the percutaneous penetration of pesticides in man which have been accomplished thus far have been made by Maibach and co-workers.[2] Using radioactive labeled pesticides they were able to determine approximately what fraction of an applied dose would be absorbed through the skin. In this way they not only compared the degree of dermal absorption for certain pesticides but also compared absorption of a single pesticide for different parts of the human body. The results obtained indicate that sufficient importance may not have been attached to protection of certain body areas.

In checking dermal penetration of parathion at different body areas these researchers found that the area of greatest absorption on man is the scrotum where approximately 100% of an applied dose was absorbed. The possibility of pesticide on this body area being completely absorbed is a very important point and emphasizes the need for increased concern about protection of the area. Of utmost importance would be the need for extreme caution in order to avoid spillage of highly toxic liquid pesticide onto the scrotum.

Although cloth overalls or trousers provide a reasonable amount of protection where contamination does not easily penetrate clothing, the wearing of waterproof trousers provides the best protection for the lower trunk and leg areas and is especially recommended in work situations where there is chance of liquid spillage, soaking by continued contact with more dilute liquid sprays, or penetration of clothing through excessive contact with dry pesticides. Even though regular clothing is covered by waterproof protective gear, it is important that the worker change to freshly laundered clothing each day in order to prevent contamination of the scrotum or other skin areas. Needless to say, use of clean clothing and daily bathing in an effort to avoid excess dermal absorption are essential in any type of exposure situation.

Protection of the upper trunk and arms from contamination by toxic pesticides is important, especially under conditions where heavy spray drift may thoroughly wet cloth shirts, coveralls, and underclothing or where concentrated dry pesticides come in contact with clothing and skin. Our studies have shown that the greatest potential contamination of spraymen in this general body area is the upper back, shoulders, and forearms of workers operating equipment which propels spray up into the air where it is more subject to drift. Under these conditions a waterproof jacket or raincoat provides the best protection for this general body area. This gear is usually worn during cooler conditions, but as the temperature rises and the clothing becomes unbearably hot to wear, workers tend to discard them and work with much less protection—perhaps only a short-sleeved T-shirt-type undershirt on the upper trunk area. Under such conditions workers should be encouraged to at least wear a long-sleeved cloth jacket that will not be easily penetrated by pesticide, and preferably one that can be properly washed.

The wearing of long-sleeved heavy grade "GI" cotton shirts or coveralls as outer clothing during hot weather, often with no underclothing, is popular with many applicators even though this is not a recommended practice. Fortunately, these items of outer clothing provide a reasonable amount of protection where spray drift is light with very fine droplets that do not wet through to the skin. Under such conditions the clothing should be changed and laundered daily. If clothing used during spraying such as shirts, jackets, or coveralls are merely hung up to dry after work and used repeatedly, as is often the practice, it doesn't take long for the pesticide material to work through where it will make contact with underclothes or skin.

In selecting protective clothing for workers it is important to take into consideration the comfort of the individual when he wears such items. The conventional black or dark green rubberized or plastic waterproof jackets in common use during past years are considered by many applicators to be uncomfortable to wear not only because of greater heat absorption but also because they may be of heavy grade material and not very flexible. During recent years, however, several jackets and jacket-trouser combinations that are lighter in color and weight have been available. Although less durable, they are less costly to replace. Nevertheless, there is still considerable discomfort in wearing any waterproof clothing during hot weather because of trapping of body heat.

Disposable paper jackets have been tested and found suitable for use only under conditions where heavy wetting does not occur. Such paper jackets were found to be much cooler and thus more comfortable than other jackets tested.

Observations of pesticide applicators have indicated that although waterproof clothing items, and especially jackets, are usually carried by the worker, or readily available to him, he usually will not don the clothing until drift of pesticide increases to the point where he feels protection is necessary. Unfortunately, by this time there is often considerable contamination of skin and clothing. The covering of contaminated skin areas by waterproof clothing may create conditions under which dermal absorption may be increased. This may be more important during hot weather where high temperatures and perspiration are involved. Whether or not there would be less absorption under these conditions than if the clothing were left off entirely depends upon the potential exposure which might occur after the worker puts on the clothing. Although the increase of absorption of pesticide by covering contaminated skin with various items of protective clothing is not known, it is important to emphasize the need to put on protective gear *before* the skin has been contaminated to any great degree.

Results of the dermal absorption studies noted above indicate that the head-neck area should be given more attention. In this area absorption of parathion was found to be from 32% to 47% of an applied dose,[2] much more than we would have anticipated and more than at other areas of the body studied with the exception of the armpit and scrotum. When observing pesticide applicators it is easy to conclude that the face-neck area is less protected than most other parts of the body.

Protection from downward drift is especially important during application of liquid sprays. The headgear most commonly used by pesticide applicators is the billed cap which provides some protection for the face but very little for the remainder of the head-neck area other than the scalp. The conventional "Sou'wester" rain hat, often used when heavy downward drift occurs, does not provide exceptionally good protection for the face and sides of the neck. This is because of the narrow brim in all areas except at the back of the neck. Metal or fiber "hard hats" are also used to some extent; however, most have too narrow a brim to provide adequate protection. "Hard hats" which allow circulation of air over the head under the hat should not be used where exposure is to toxic dusts.

Our studies have shown that the greatest protection from downward drift of pesticides is afforded by some type of wide-brimmed hat, perferably made of water-repellent material. Waterproof hats, other than the "Sou'wester," were not readily available at that time. However, one is now available which is waterproof and also has a wide brim that affords good protection of the face-neck area. This type of hat should be recommended for use by all applicators who may be subjected to downward drift of pesticides.

Of particular interest in relation to exposure of the head-neck area is the finding by Maibach *et al.*[2] that absorption of parathion is relatively efficient (47% of applied dose) in the ear canal. Exposure in this area could occur through drift of fine pesticide mists or dusts or by digging in the ear with the tip of a contaminated finger.

It is of importance to note that wearing goggles and respirators provides considerable protection to the face.

Although a statement suggesting the use of goggles can be found on certain pesticide labels, they are rarely worn except by pilots who apply pesticides by aircraft. Questioning of pilots has revealed that they wear goggles not only to prevent poisoning and to keep wind out of the eyes but also to prevent certain organophosphorus pesticides that are direct inhibitors of cholinesterase from causing moisis. This is understandable because it has been shown that unilateral contamination of the eye with TEPP may cause pilots to inadequately judge distance.[3] The incoordination which may accompany this could be a serious threat to safety.

The hands are often the body area having the highest exposure to pesticides and they have a greater chance of coming in contact with the more concentrate formulations. They are also more subject to cuts or abrasions, which will be discussed later. High potential exposure to the hands brings attention to the need for wearing gloves. Some people who have worked with pesticides feel it is better not to wear gloves than to wear gloves that are contaminated on the inside; something which invariably occurs to some degree. Our research concerning the use of protective gloves indicates that, unless there is gross contamination of the inside of the gloves, the potential exposure is less when wearing gloves than when not wearing them. If gloves are kept clean on the inside there is very little doubt concerning the value of their use when handling pesticides. Unlined rubber gauntlet gloves provide the best protection because the gauntlet covers the wrist area not normally covered by the jacket sleeve and they can be turned wrong side out for proper cleansing of the unlined inside surface.

In order to provide proper protection to the feet, waterproof shoes or boots should be worn when handling or applying pesticides on a large scale. When leather shoes become wet with spray material they have a tendency to become cracked and dried out to the extent that pesticide easily penetrates through to the sock or foot. Both leather and canvas shoes absorb chemicals and may hold them in contact with the wearer. Boots should be washed and dried thoroughly, inside and out, as frequently as needed to remove any pesticide contaminant.

Entry Through Cuts or Abrasions: Any break in the skin may allow a more direct route of entry into the blood stream. Even if the outer layer of dead cells (strateum corneum) of the skin is removed by scratching or scuffing the result may be a potential for increased absorption at that site as this layer of cells is considered the main barrier against chemicals. This route of entry is one that may not have received enough attention in the past. Cuts and abrasions occur most frequently on the hands, and unfortunately, the hands are the body area most often in contact with the more concentrate forms of pesticides. There have been poisoning cases suspected as having been a result of entry by this route; however, there has not been enough evidence to definitely prove that this route played the major part in the illnesses.

One suspected poisoning case which might be used as an example involved a 25-year-old worker in a pesticide plant whose finger was crushed by a fork lift which appeared to be contaminated with concentrate parathion.[4] For several weeks prior to the accident he had been working primarily with carbaryl, along with a small amount of malathion, but nothing as toxic as parathion. The worker became severely ill and exhibited symptoms of poisoning within approximately 30 minutes of the accident, a coincidence which aroused suspicion that the illness was associated with the accident. Analysis of a blood sample showed cholinesterase activity to be very low. There was prompt clinical response to administration of atropine and 2-PAM. Although there does not appear to be enough evidence to prove entry of pesticide at the area of broken skin, the circumstances around the case indicate that this route of entry could possibly have played a major part in poisoning. In such case poisoning symptoms may not have developed had the worker been wearing gloves.

Another suspected case involved broken skin on the feet of a 54-year-old male who wore canvas shoes while spraying an apple orchard.[5] His shoes became soaked with the dilute spray from walking through wet cover crop. He had complained of "scalded feet" indicating raw, red, oozing areas especially on his soles and between his toes. On several occasions he was aided in bandaging his feet or procuring tape, etc. by co-workers. He had sprayed for several days but on the day of his death he had sprayed for 9 hours, wearing canvas shoes all day. A post-mortem blood sample showed very low cholinesterase. The physician investigating the case indicated that cause of death was parathion poisoning due to probable dermal absorption, particularly through an area of dermatitis on both feet. Because body areas other than the feet were exposed there is no complete assurance that this was the main route of entry of the compound. Nevertheless, this case points out the importance of wearing rubber boots or shoes while applying liquid pesticides.

Respiratory Route: Where toxic dusts and vapors or very small spray droplets are prevalent, or where application is in confined spaces, protection of the respiratory route is especially important. Extremely fine particles and droplets found in dusts and mists are much more easily drawn into the respiratory system than the larger droplets formed by most conventional dilute spray machines. Our tests have shown that when operating an 8X (eight times the normal dilute concentration) concentrate airblast machine in fruit orchards the potential respiratory exposure is nearly 3 times greater than when operating the conventional dilute machine.[1]

The cartridge-type respirator provides adequate respiratory protection in most types of application situations. In certain cases it is advisable to use gas masks with special canisters because of their greater adsorbent capacity. Applicator pilots who risk the possibility of flying through drift of fine droplets or dusts should use a face mask equipped with a filter canister and attached either to their belt or to the inside of the cockpit. When fumigating or applying highly toxic pesticides in confined spaces it is advisable to use a respirator with a special compressed air supply tank so that none of the contaminated ambient air is inhaled.

If respirators are to be effective they must have proper care. The rubber face-piece becomes hardened and the head straps lose their elasticity with age and exposure to heat and sunlight. These conditions lead to poor fit and allow leakage around the face-piece. Two of the more common offenses in the care of respirators that we have observed are (1) failing to occasionally wash the face-piece with soap and water and (2) neglecting to change the filter cartridges or canisters regularly. Washing of the face-piece of a cartridge-type respirator should not be attempted while the cartridges are in place as moisture may contact the activated charcoal filter material and reduce its effectiveness in adsorption and absorption of pesticides. Solvents should not be used as a cleaner for they may damage certain parts of the respirator. The general recommendation is that cartridges should be changed after 8 hours of continuous exposure. In most application situations this leaves much up to the individual worker to keep a record of his respirator exposure time. In a formulating plant where hours of exposure are more regular this is more easily controlled under the guidance of a foreman. Under conditions of intense exposure the useful life of the cartridge is much shorter. Thus, if the breathing seems hampered, or if the odor of pesticide is detected, the filter cartridges should be changed immediately. If the outer filter pads are separate removable units they should be changed more frequently than the cartridges.

During discussions of the respiratory route of entry into the body the question is often raised concerning the hazard of smoking pesticide-contaminated cigarettes. We have found it difficult to measure such potential exposure with any great degree of accuracy. The technique we have utilized thus far involves subjecting the cigarettes to normal handling through the process of removing them from the pack and placing them in the mouth, lighting them, and smoking one-half the cigarette. The remainder of the cigarette is then analyzed for pesticide content. The values obtained are based on the assumption that pesticide on the cigarette will be volatized before being broken down by burning and that none of the volatile or particulate pesticide would be trapped in the butt end of the cigarette. In observing smoking by workers it was noted that the area of greatest contamination of the cigarette was far enough from the butt end to allow burning of the contaminated area in most cases.

In studies of cigarette contamination by spraymen applying endrin in orchards, the potential exposure through smoking during application operations was calculated to be not more than 0.002 mg per cigarette, even when the cigarettes were handled with hands wet with the dilute spray.[6] In later studies[7] involving spraymen applying parathion to apple orchards by airblast machines, from 0.003 to 0.005 mg of parathion per cigarette could be recovered where they were handled with hands that were contaminated but dry. When handled with hands that were wet enough with dilute spray to leave moist spots on the cigarette paper from 0.020 to 0.050 mg could be found. In a controlled study designed to determine what might be the maximum contamination of cigarettes through such handling, hands were dipped in 45% emulsifiable concentrate parathion, the hands wiped off lightly on the trousers, and the cigarettes were handled to simulate smoking. The highest value found was 0.235 mg per cigarette.

Even though values for potential respiratory exposure through smoking contaminated cigarettes may not appear to reflect any great hazard, two important points must be kept in mind: (1) Pesticide entering by the respiratory route is practically 100% absorbed, and (2) There is no assurance that a more toxic breakdown product will not be formed and inhaled as the high temperature of a burning cigarette reaches the contaminated areas rather than complete destruction of the compound by burning. For example, in the case of parathion the oxidation product, paraoxon, is estimated to be much more toxic than the parent compound, possibly 100 to 500 times more toxic. This could be an important factor as far as hazard is concerned and emphasizes the need for recommending washing of hands and face before smoking.

Oral Route: Oral exposure is difficult to measure. We are studying techniques at the present time. Analysis of saliva samples of exposed individuals appears to give some indication of contamination. Splashing of liquid concentrate into the mouth while pouring and measuring pesticides may produce the most serious oral exposure. Contamination may also occur through licking the lips, by rubbing the mouth with contaminated arms or hands, by careless actions such as attempting to blow out clogged spray nozzles with the mouth, or by eating or drinking with contaminated hands.

We have attempted to measure the parathion contamination of typical sack lunch items, such as sandwiches, cookies, and pickles by workers whose hands had been contaminated while thinning fruit in recently sprayed apple orchards.[8] A lunch consisting of four half-sandwiches, two cookies, and one pickle was given to workers who handled and ate one-half of each item with unwashed hands. The other half of each item was analyzed for parathion. This provided potential oral exposure values for lunch items. A total of approximately 0.103 mg of parathion was found on the typical lunch mentioned above. Although this is not a great amount of pesticide, it would add to the total exposure of each individual; thus, workers should wash hands and face before eating.

Discussion: Workers who handle pesticide compounds must realize that there is some element of risk involved. Accidents do occur, even among workers who are careful. In case of accidental gross contamination of skin with a highly toxic compound every effort must be made to cleanse the contaminated area as quickly and as thoroughly as possible. The best recommendation at present is the use of plenty of soap and water. Wash by rubbing with the hands or with a piece of cloth. Do not scrub with a brush because the outer protective layer of the skin may be abraded enough to allow more rapid absorption of any pesticide not removed. A bar of soap, towel, and container of water should be carried on every pesticide application machine or accompanying vehicle for use in washing should a spillage occur. If pesticide gets in the eyes they should be thoroughly flushed with water for at least five minutes. If a person should feel ill while working with pesticides he should stop work at once and get medical attention. If his illness is diagnosed as being caused by a pesticide he should not return to work until a physician advises that it is safe to do so.

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exhibit f.

COMPLIANCE WITH OPERATIONAL STANDARDS

In order to assure accurate inspection and treatment of mosquito producing and harboring sites by employees, the District has published and provided each employee with a Field Operations Manual. A great portion of this manual is given to defining the procedure for the inspection and treatment of sites. Becoming familiar with and following the procedure set forth by the manual are mandatory for employment at Metropolitan Mosquito Control District.

To insure compliance to the procedure set forth in the manual several methods are used:

A. District foremen are charged with the responsibility of training seasonal employees at the beginning of their employment with the District.

B. District foremen are charged with the responsibility of spending 25 to 50 percent of their time "back-checking" and evaluating the work of the seasonal employees in their charge.

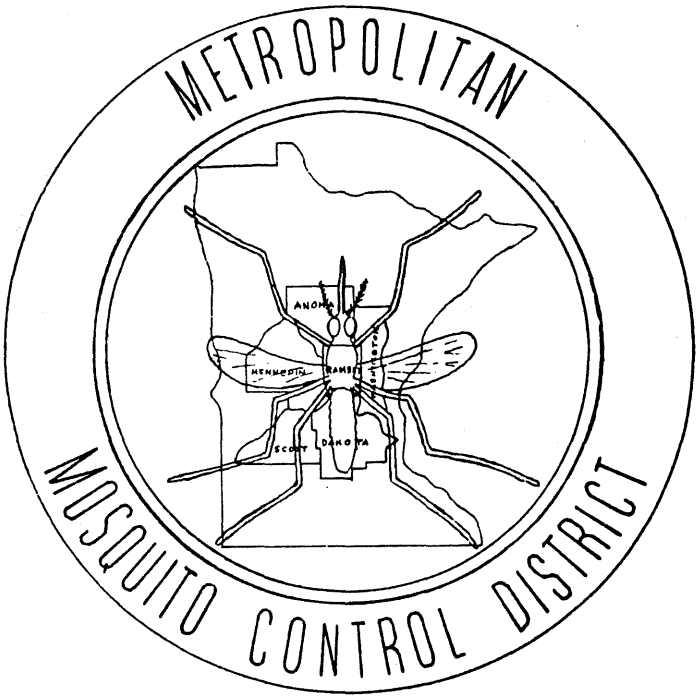
C. The District has devised a dual bookkeeping system. At each level of the system checks are included to insure proper dosage rate of materials used and proper amounts of work performed by employees on a daily, weekly, monthly and annual basis.

D. County Supervisors are charged with the responsibility of administering the three programs mentioned above in their respective counties. They are further charged with the responsibility of making random spot checks on all employees to insure control levels.

E. Coordinating Assistants are charged with making random spot checks and assisting the County Supervisor in carrying out the above mentioned programs in his county.

Attached to this section is the portion of the manual which deals with the procedures for insuring compliance with operational standards, all of the forms, and an explanation of the bookkeeping system.

FIELD OPERATIONS MANUAL



METROPOLITAN MOSQUITO CONTROL DISTRICT
1802 COMO AVENUE
ST. PAUL, MINNESOTA 55108
TELEPHONE 612-645-9149

FOREMAN's CHECKLIST

To minimize problems of operational loss, such as vehicle damage, sanitation, equipment condition etc. each foreman should periodically, 2 or 3 times a week, review the condition of work units in his charge. This should be done before or between shifts. A suggested checklist follows to facilitate quick review. Each seasonal employee should review the checklist and police his or her own vehicle and equipment.

A. Vehicle Damage
_____1. Dents
_____2. Bumpers
_____3. Windshield (cracks, rock punctures, etc.)
_____4. Scratches (fenders, hood, cab top, etc.)
_____5. Lights (head, tail, cargo, beacon, flashlite, etc.)
_____6. Faulty equipment (mirrors, dash, etc.)

B. Vehicle Sanitation
_____1. Litter bag (present, emptied for next shift)
_____2. Cab (dash, floor, seat, glove box cleaned and organized)
_____3. Bed (floor free of residue, equipment and material organized)
_____4. Back bumper and lights (free of insecticide and dirt residue)

C. Equipment Condition
_____1. Cold fog units (clean and functional)
_____2. Seeders (clean, functional and accounted for)
_____3. Oilers (clean, functional and accounted for)
_____4. Dippers (clean, secure and accounted for)
_____5. Boots (clean, stored properly, accounted for)
_____6. Tool box (accounted for)
_____7. Liquid containers (clean and free of leaks)
_____8. Garbage Cans (with tops on)
_____9. Side box (clean, secure with thermos, soap, toweling and 1st aid kit)

D. Materials

_____1. Dry material (to be left in sacks, secure and protected.)
_____2. Liquid material (secure, marked and in proper containers.)

E. Bookwork Organization
_____1. Maps returned to proper book and foreman.
_____2. FF2, FF9, FF25, etc. returned to foreman.
_____3. Notes, information, assignments written and left for foreman.

Inspection and Treatment Procedure

I. Section maps and cards.

A. The Metropolitan Mosquito Control District maintains up to date section maps for each control division. These maps are used by seasonal employees to locate mosquito breeding and adult harboring sites.

B. Breeding sites are normally outlined in red and have a sequential number within that section assigned to them.

C. Adult harboring sites are wooded areas which have a letter assigned to them.

D. Information on the site is recorded on the section card (FF-4) which follows the section map.

Information on the section card.

1. Site number or letter.
2. Size in acres or tenths of acres.
3. Type of site (temporary water permanent water etc.)
4. Other pertinent information pasture or sensitive site etc.

E. Information on the inspection and treatment of a site will be recorded in the space provided for this information next to the information..

Information to be recorded.

1. Date
2. Percent of the site that is wet.
3. Larva or pupa per dip or number of adults collected in 5 minutes.

4. Employee number

5. A column to check when the site is treated (Note - see Exhibit A for information on items D and E)

II. Inspecting and treating mosquito breeding sites for larva and or pupa.

A. Equipment and materials needed.

1. White enamel dipper.

2. Sample bottles

3. Eye dropper

4. Bottle labels

5. 50% alcohol solution

6. Boots

7. Application equipment and control materials

B. Procedure for inspecting and treating sites.

1. Find the site on the section map

2. Locate the site in the section.

3. Read the information on the site found on the section card.

4. Using the white enamel dipper check for the presence of mosquito larva or pupa. (Note - see section on mosquito larva and pupa in this manual.)

a. When larval densities are above 5/dip (5 to 10 dips per site are adequate) treat the site.

b. When the number per dip is less than 5, more dip samples should be taken to accurately determine the population levels, particularly when a decision is needed on whether to treat an air site.

Exhibit A

Site Identification (Item D Inspection and Treatment (Section Card) procedure).

1. Number or letter of breeding site or adult site. These numbers or letters correspond to numbers and letters assigned to breeding and adult sites on the section map.
2. Number of acres or tenths of acres included in the site.
3. Type of site.

   #1 Temporary Floodwater

   #2 Woodland or early spring mosquito site

   #3 Permanent water

   #4 Ditch site

   Color Code:

   Red - likely to produce human biting mosquitoes

   Blue - not likely to produce human biting mosquitoes

   Yellow - normally a dry site.

   Black - information on the site does not exist
4. P - denotes pasture site

   S - denotes sensitive site

Exhibit A

Inspections (Item E. Inspection and treatment (section card) procedure).

1. Date - date site was inspected and/or treated

2. % wet - percent of the site that is wet

3. L.P./ No. - average number of larvae and/or pupa found per dip or A.
number of adult mosquitoes collected in a 5 minute sample. Record L, P or A above the slash mark and number found below the slash mark.

4. Record employee number.

5. Treated-record a check mark in this space if you treat the site.*

6. Species (red-blue) - the laboratory will identify the species of the larvae sent in from the field and sent back a species sheet to the Foremen. They will in turn record a check mark in the proper column.

   Red - human biting mosquitoes

   Blue - non human biting mosquitoes

*If the treatment is a residual or prehatch treatment, record the amount of material used per acre in the space marked treated, ie. if the treatment is a residual treatment of Dursban at 5 lb./acre, put 5 in the space. If the treatment is a prehatch treatment of Dursban at 10 lb/acre, put 10 in the space.

Bottle or box label (Item II Inspecting and treating mosquito breeding sites B4c and Item III Inspecting and treating adult mosquito harboring sites B4c.)

Co. 1 Twp. 2
Sec. 3 B.S. 4
T.B.S 5 Date 6
Coll. 7
T. 8 NT. 9 G. 10 A. 11
No./D 12 Time 13

1. County number
2. Township number
3. Section number
4. Breeding site number or adult site letter
5. Do not use.
6. Date the sample was taken
7. Your foreman's employee number
8. Record a check mark if you treat the site.
9. Record a check mark if you do not treat the site.
10. Record a check mark if the site is a ground site.
11. Record a check mark if the site is an air site.
12. Average number of larvae or pupae per dip or number of mosquitoes collected in a 5 minute biting collection.
13. Record number of minutes spent on the biting collection if less than 5.
14. Put a red slash mark across all air site labels. These labels are to be attached to the sample bottle or box containing the specimens sent to the laboratory for identification.

Metropolitan Mosquito Control District Daily Inspection and Treatment Report.

Top of sheet:

1. County number
2. Date the work shown on the report, was done.

3-4-5. Employee number of person or persons who completed inspections and treatments.

6. Material codes - gives name of material and amount to apply per acre. The material number should be recorded in the material code column (28) when that material is used in the treatment of a site.

Site Identification:

7. Township number of section being worked.
8. Section number being worked
9. Breeding site number or adult site letter of site inspected or treated.

Inspection Record:

10. Wet and breeding - check this column if applicable.
11. Wet and not breeding -check this column if applicable
12. Dry - check this column if applicable.
13. Larvae/pupa per dip - record the average number per dip of larvae or pupae found in the site.

    Adults per 5 minutes - record the number of adult mosquitoes collected in 5 minutes.

14. %wet - record the percent of the site that is wet.

Type Inspection: (check only one of the following)

15. Ground L. - check this column for a ground larviciding inspection.

16. Ground A. - check this column for a ground adulticiding inspection .
17. Air L. - check this column for an air larviciding inspection.
18. Air A. - check this column for an air adulticiding inspection.
19. P. H. - check this column for a prehtach inspection.
20. Post Treat. - check this column for a re-inspection of a site that was previously treated.
21. BioControl - check this column if it was an inspection of a biological control site.
22. Source reduction - check this column if it was an inspection of a site in the source reduction program.

Type Treatment:

23. Ground L. - check this column if it was a ground larvicide treatment.
24. Ground A. - check this column for a ground adulticide treatment.
25. P. H. - check this column for a ground prehatch treatment.
26. FF-9 - check this column for a treatment requested by a citizen.
27. 600-700 - Check this column if it was a treatment of a tree hole (600) or artifical container (700).

Treatment Record:

28. Material Code - enter the number of the material that was used to treat the site (find material code numbers under item #6).
29. Gallons, ounces, pounds - enter the number of gallons, ounces or pounds of material actually used to treat a site in this column.
30. Treated Acres - enter the number of acres actually treated in this column.
31. Remarks - enter remarks on the inspection and treatment of sites in this column.

32. Totals - at the end of the shift total all columns with the exception of 7, 8, 9, 13, 14, 28 and 29.

General Instructions:

1. When a site is inspected but not treated on the same day, complete the inspection record. If you return to the site to perform the treatment the next day do not re-record the inspection report, fill in the site identification, type treatment and treatment records.
2. PLEASE use legible penmanship - others must read these reports.
3. PLEASE be accurate in totaling the columns others must use these reports and accurate information is mandatory.
4. Turn your FF2 in to your Foreman at the end of your shift.

METROPOLITAN MOSQUITO CONTROL DISTRICT

DAILY INSPECTION AND TREATMENT REPORT

COUNTY 1

DATE 2

FOREMAN 3

INSPECTOR 4

INSPECTOR 5

MATERIAL CODES & PER ACRE DOSAGE RATES 6

1 FUEL OIL	1-3 GALS.	8 MALATHION 5 LB.	8.4 FL. OZ.
2 ABATE 1%	2.5 LBS.	9 RESMETHRIN 40%	8.1 FL. OZ. F.S.
3 MALATHION 5 LB.	12.5 FL. OZ.	10 RESMETHRIN 40%	1.5 FL. OZ. F.S.
4 ABATE 1%	5 LBS.	12 DURSBAN 1% SAND	5 LBS.
5 RESMETHRIN 18.5%	1.5 FL. OZ. F.S.	13 DURSBAN 1% SAND	10 LBS.
6 RESMETHRIN 18.5%	8.1 FL. OZ. F.S.		

NUMBER	SITE IDENT.			INSPECTION RECORD					TYPE INSPECTION								TYPE TREATMENT					TREATMENT RECORD			REMARKS
	TWP.	SEC.	B.S. OR A.S.	BRED	WET NO BRED	DRY	L/P PER DIP / ADULTS 5 MIN.	% WET	GROUND L.	GROUND A.	AIR L.	AIR A.	P.H.	POST TREAT	BIO CONTROL	SOURCE REDUCT.	GROUND L.	GROUND A.	P.H.	FF 9	600/700	MAT CODE	GALS OZ. LBS.	TREATED	ACRES	
	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		31
1																										
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										
13																										
14																										
15																										
16																										
17																										
18																										
19																										
20																										
21																										
22																										
23																										
24																										
25																										
26																										
27																										
28																										
29																										
30																										
FF-2 REVISED 1-77 TOTALS				32																						

METROPOLITAN MOSQUITO CONTROL DISTRICT

TABLE FOR DETERMINING SMALL ACREAGES

ACRES	SQ. FT.	EXAMPLES 36 INCH PACES
1.0	43,560	75 x 64 or 50 x 97
0.9	39,204	75 x 58 or 50 x 87
0.8	34,848	50 x 77
0.7	30,492	50 x 68
0.6	26,136	50 x 58
0.5	21,780	25 x 96 or 50 x 48
0.4	17,424	25 x 77 or 50 x 39
0.3	13,068	25 x 60 or 50 x 29
0.2	8,712	25 x 39
0.1	4,356	25 x 19

When you are in doubt about the actual size of a site or the area of a site to be treated take the time to "walk it off" in order to determine the size.

20. Material code - enter the number of the material that was used to treat the site. (Find material code numbers under Item 12)

21. Gallons, ounces, lbs - enter the number of gallons, ounces or pounds of material actually used to treat a site in this column.

22. Treated acres - enter the number of acres actually treated in this column.

23. Pre. treat. - Enter the average number of mosquito larva per dip or number of adult mosquitos collected in five minutes prior to the treatment of the site.

24. Post Treat. Enter the average number of mosquito larva per dip or number of adult mosquitos collected in five minutes after the treatment of the site.

25. %Control - To find the percentage of control multiply the number found in the post treatment inspection by 100 and divide by the number found in the pre treatment. inspection. Enter this number in the % control column.

26. Remarks - Enter pertinent remarks about sites being treated in this column.

27. Pilots signature - the pilot must sign the form after the completion of the work.

28. Other employees - record employee numbers of other people assiting in the operation in this column.

29. Remarks - record other remarks on this operation in this space.

General Instructions:

1. Please use legible penmanship others must read these reports.

2. Please be accurate in totaling the columns others must use these reports and accurate information is manditory.

H. Procedure for completing the FF-10 (Aerial Insecticide Application Report).

1. See Exhibit A in this section.

Metropolitan Mosquito Control District Aerial Insecticide Application Report.

1. Date work is done.
2. Employee number of Foreman conducting the air work.
3. Type of aircraft used.
4. Aircraft Federal Aviation Agency identification number.
5. Pilots name
6. Starting time of operation.
7. Finishing time of operation.
8. Record total time involved in the operation.
9. Record the wind speed at the start and finish of the operations.
10. Record the wind direction at the start and finish of the operation.
11. Do not write in this space
12. Material code -gives name of material and the amount to apply per acre. The material number should be recorded in the material code column (20) when that material is used in the treatment of a site.
13. County number
14. Check this space if it was a larval treatment.
15. Check this space if it was an adult treatment.
16. Check this space if it was a prehatch or residual treatment.
17. Township number of section being worked.
18. Section number of section being worked.
19. Breeding site number or adult site letter of site being treated.

METROPOLITAN MOSQUITO CONTROL DISTRICT

AERIAL INSECTICIDE APPLICATION REPORT

OFFICE USE ONLY 11
FLIGHT NO.
TOTAL ACRES
PRICE PER ACRE
TOTAL AMOUNT

DATE 1 EMPLOYEE NO. 2

AIRCRAFT: TIME OF OPERATION:

TYPE 3 START 6

FAA NO. 4 FINISH 7

PILOT'S NAME 5 TOTAL TIME 8

WIND: M.P.H. START 9 FINISH DIRECTION START 10 FINISH

COUNTY 13 TYPE TREATMENT: LARVA 14 ADULT 15 P.H. 16

12

MATERIAL CODES	
GROUP 4	LARVACIDE
16 ABATE 1%	5 LB. PER ACRE
17 ABATE 4 LB.	6 OZ. PER ACRE
18 DURSBAN 4 LB.	17 OZ. P/GAL. F.S.
19 MALATHION	13 OZ. PER ACRE
GROUP 5	ADULTICIDE
22 DURSBAN 4 LB.	10.25 P/GAL. F.S.
GROUP 6	P.H. & RESIDUAL
25 DURSBAN 1%	5 LB. PER ACRE
26 DURSBAN 1%	10 LB PER ACRE
27 DURSBAN 4 LB.	34 OZ. P/GAL. F.S.

NUMBER	SITE IDENTIFICATION			TREATMENT RECORD			INSPECTION RECORD		% CONTROL	REMARKS
	TWP	SEC.	B.S. OR A.S	MAT. CODE	GAL. OZ. LBS.	TREATED ACRES	AVERAGE L/P PER DIP ADULTS PER 5 MIN. PRE TREAT.	AVERAGE L/P PER DIP ADULTS PER 5 MIN. POST TREAT.		
1	17	18	19	20	21	22	23	24	25	26
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

PILOT'S SIGNATURE 27 OTHER EMPLOYEES 28

REMARKS: 29

FP-10 REVISED 3-76

BIOLOGICAL CONTROL FIELD OBSERVATION OF PERMANENT WATER SITES

The biological control field observations of permanent water sites (LFF-1) is a form that will be used to identify sites within the District in which mosquito breeding is under control by biological agents. In the "Guidelines for larval mosquito control measures for permanent water sites", when the larval density is less than 5 larvae/dip and predators are present or Lemna (duckweed) covers 70% or more of surface area then the instructions are to complete lab field form-1 and route it to the Research Lab. An example of a completed form is shown on the following page.

BIOLOGICAL CONTROL FIELD OBSERVATIONS OF PERMANENT WATER SITES.

DATE 7/5/76

EMPLOYEE NO. 1900

COUNTY 19

NAME: Mike Smith

TWP. 11

SEC. 07

B.S. 111

ACRES 10

If present see Key in manual and attempt identification.

	Present	Absent
Larval Predators	[x]	[ ]

Noteonecta

Lemna (Duckweed)	[ ]	[ ]

If present record percentage of surface covered.

Larval Density 2 Per Dip Average 10 dips

Other observations and suggestions

Large numbers of backswimmers observed in site, much aquatic vegetation present. Would like someone form lab to visit site.

LFF-1 (Route to Research Lab.)

PROCEDURE FOR COMPLETING THE CONTROL DIVISION FIELD OPERATION RECORDS

A. Weekly Inspection and Treatment Report (Page 1 and 2).

1. Collect all Daily Inspection and Treatment Reports (FF-2) and Aerial Insecticide Application Reports (FF-10) for the week.
2. Assemble the reports in order by employee number.
3. Total all inspections and treatments and record them on the form by employee number.
4. Total all inspection and treatment columns on the weekly inspection and treatment report.

B. Weekly Ground Insecticide Use Report

1. Assemble all FF-2's for the week by employee number.
2. On a separate sheet total all material used by material code number and acres treated with each material by employee number.
3. Record totals for each employee on the weekly ground insecticide use report.
4. Total all columns on the weekly ground insecticide use report.
5. Liquid material, with the exception of Fuel Oil, is recorded in ounces on the FF-2, this figure must be converted to gallons. Divide ounces of liquid material by 128 to convert to gallons.

C. Weekly Air Insecticide Use Report

1. Assemble all FF-10's for the week.
2. On a separate sheet, total all material used by material code number and acres treated with each material by

employee number.

3. Record totals for each employee on the weekly air insecticide use report.
4. Total all columns on the weekly air insecticide use report.
5. Liquid material is recorded in ounces on the FF-10, this figure must be converted to gallons. Divide ounces of liquid material by 128 to convert to gallons.

D. Monthly Inspection, Treatment and Insecticide Use Report (Page 1 and 2).

1. At the end of the month, total all weekly inspection and treatment reports, weekly ground insecticide use reports and weekly air insecticide use reports.
2. Record totals for the month on the monthly inspection, treatment and insecticide use report in the proper columns.
3. Total all acres treated by group and record in the proper space provided.
4. Combine totals of various materials and record total amount of material in the proper column in the total material used section.

Example: Abate 1% on Celatom Granules.
Material Code 2 and 16 are the same material, combine the totals for these two material codes and record under Abate 1% Celamtom Granule in the total material used section.

5. Adjust Gallons

   a. Liquid material used is recorded in gallons of finished spray material.

   b. You must convert gallons of finished spray material to gallons of actual concentrate material.

   c. Take the total number of gallons of finished spray material multiply it by the amount of concentrate per gallon of finished spray and divide that figure by 128 to find the adjusted gallonage figure.

6. New Material

   a. If a new material is used space is provided for the addition of this material.

   b. Write the new material in one of the spaces provided and total the colums.

E. Supervisors Inventory of Insecticide

1. At the end of each week and at the end of each month the County Supervisor will inventory all insecticide material in his control division.

2. This inventory will be taken at the end of the last day worked in that week it will also be taken at the end of the last working day of the month.

F. Supervisors Inventory Work Sheet

1. This form is provided to aid the person taking the inventory of material on the trucks and in the shop.

G. Copies of Reports

1. The weekly inspection and treatment reports, weekly ground insecticide use reports, weekly air insecticide use reports and supervisors inventory of insecticide should be brought to the Main Office on the day of the weekly Staff Meeting. Copies of these reports should be made and routed to the Coordinating Assistant.
2. At the first Staff Meeting after the end of the month the monthly inspection, treatment and insecticide use report and Supervisors inventory of insecticide should be brought to the Main Office. Copies of these reports should be made and routed to the Coordinating Assistant.

H. Record keeping

1. Daily Inspection and Treatment Reports (FF-2) and Aerial Insecticide application Reports (FF-10) should be kept on file at the control division offices.
2. These reports should be filed by the week.
3. The control division field operation records should be kept in the booklets and should be filed by the month.

I. Frequency of Operational Records

1. Operational records for the week should be completed on the Monday following the work week to be recorded.
2. On the day following the last day of the month the operational records for that partial work week and the monthly operational records should be completed.
3. Spare copies of all forms will be available at the Main Office.

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COUNTY_____

WEEK OF_____

WEEKLY INSPECTION AND TREATMENT REPORT

MMCD 3-76

EMPLOYEE NUMBER	INSPECTED	WET BREEDING	WET NOT BREEDING	DRY	GROUND LARVAL INSPECTIONS	GROUND ADULT INSPECTIONS	AIR LARVAL INSPECTIONS	AIR ADULT INSPECTIONS	PRE-HATCH INSPECTIONS	POST TREATMENT INSPECTIONS
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
TOTALS										

MONTHLY INSPECTION, TREATMENT AND INSECTICIDE USE REPORT

COUNTY_____MONTH_____

INSPECTED	WET BREEDING	WET NOT BREEDING	DRY	GROUND LARVAL INSPECTIONS	GROUND ADULT INSPECTIONS	AIR LARVAL INSPECTIONS	AIR ADULT INSPECTIONS	PRE-HATCH INSPECTIONS	POST TREATMENT INSPECTIONS
BIOLOGICAL CONTROL INSPECTIONS	SOURCE REDUCTION INSPECTIONS	GROUND LARVAL TREATMENTS	GROUND ADULT TREATMENTS	PRE-HATCH TREATMENTS	FF-9 TREATMENTS	600-700 TREATMENTS	AIR LARVAL TREATMENTS	AIR ADULT TREATMENTS	AIR PRE-HATCH TREATMENTS

GROUP 1 GROUND LARVACIDE								GROUP 2 GROUND ADULTICIDE												GROUP 3 GROUND PRE-HATCH & RESIDUAL							
1 FUEL OIL TO 3 GAL. PER ACRE		2 ABATE 1% 2.5 LBS. PER ACRE CELATOM GRANULE		3 MALATHION 12.5 FL OZ. PER ACRE		4 ABATE 1% 5 LBS. PER ACRE CELATOM GRANULE		18.5% 5 RESMETHRIN 1.5 FL. OZ. PER ACRE 25.6 OZ. PER GAL. F.S.		18.5% 6 RESMETHRIN 8.1 FL. OZ PER ACRE 9.3 OZ PER GAL. F.S.		7		8 MALATHION 8.4 FL. OZ PER ACRE		40% 9 RESMETHRIN 8.1 FL OZ PER ACRE 4.3 OZ PER GAL. F.S		40% 10 RESMETHRIN 1.5 FL OZ. PER ACRE 11.5 OZ. PER GAL. F.S.		11		12 DURSBAN 1% 5 LBS PER ACRE SAND GRANULE		13 DURSBAN 1% 10 LBS. PER ACRE SAND GRANULE		14 DURSBAN 1% 5 LBS. PER ACRE CELATOM GRANULE		15 DURSBAN 1% 10 LBS. PER ACRE CELATOM GRANULE	
2 OR 4 GAL. SPRAYER		SEEDER		HUDSON		SEEDER		COLD FOG		HUDSON				HUDSON		HUDSON		COLD FOG				SEEDER		SEEDER		SEEDER		SEEDER	
GAL.	ACRES	LBS.	ACRES	GAL	ACRES	LBS	ACRES	GAL	ACRES	GAL.	ACRES			GAL.	ACRES	GAL.	ACRES	GAL.	ACRES			LBS	ACRES	LBS	ACRES	LBS	ACRES	LBS	ACRES
GROUP 1 ACRES TREATED								GROUP 2 ACRES TREATED														GROUP 3 ACRES TREATED							

MMCD 3-74

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COUNTY_____
MONTH_____

SUPERVISORS INVENTORY OF INSECTICIDE

MMCD 3-76

MATERIAL	WEEK 1					WEEK 2					WEEK 3				
	AMT. BROUGHT FORWARD	+ AMT. RECIEVED	- AMT TRANS.	-AMT USED	TOTAL AMT. ON HAND	AMT. BROUGHT FORWARD	+ AMT. RECIEVED	- AMT. TRANS.	-AMT. USED	TOTAL AMT. ON HAND	AMT BROUGHT FORWARD	+ AMT. RECIEVED	- AMT. TRANS.	- AMT USED	TOTAL AMT. ON HAND
1 FUEL OIL GAL.															
2-4-16-20 ABATE 1% LBS.															
12-13 DURSBAN 1% S.G. LBS.															
14-15 DURSBAN 1% C.G. LBS.															
8-19 MALATHION 5 LB. GAL.															
17 ABATE 4 LB. GAL.															
5-6 RESMETHRIN 18.5 % GAL.															
9-10 RESMETHRIN 40% GAL.															
18-22-27 DURSBAN 4 LB. GAL.															
MINERAL OIL GAL.															
KLEAROL GAL.															
SPREADER GAL.															

MATERIAL	WEEK 4					WEEK 5					TOTALS FOR MONTH			
	AMT. BROUGHT FORWARD	+ AMT. RECIEVED	- AMT. TRANS.	-AMT. USED	TOTAL AMT. ON HAND	AMT. BROUGHT FORWARD	+ AMT. RECIEVED	- AMT. TRANS.	-AMT. USED	TOTAL AMT. ON HAND	AMT. RECIEVED	AMT. TRANS.	AMT. USED	AMT ON HAND
1 FUEL OIL GAL.														
2-4-16-20 ABATE 1% LBS.														
12-13 DURSBAN 1% S.G. LBS.														
14-15 DURSBAN 1% C.G. LBS.														
8-19 MALATHION 5LB. GAL.														
17 ABATE 4LB. GAL.														
5-6 RESMETHRIN 18.5% GAL.														
9-10 RESMETHRIN 40% GAL.														
18-22-27 DURSBAN 4 LB. GAL.														
MINERAL OIL GAL.														
KLEAROL GAL.														
SPREADER GAL.														

COUNTY_____

DATE_____

SUPERVISORS INVENTORY WORK SHEET

MMCD 8-76

MATERIAL	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	TRUCK NO.	SHOP INVENTORY	TOTAL
1 FUEL OIL GAL.														
2-4 ABATE 1% 16-20 LBS.														
12-13 DURSBAN 1% S. G. LBS.														
14-15 DURSBAN 1% 25-26 C. G. LBS.														
8-19 MALATHION 5 LB. GAL.														
17 ABATE 4 LB. GAL														
5-6 RESMETHRIN 18.5% GAL.														
9-10 RESMETHRIN 40% GAL.														
8-22-27 DURSBAN 4 LB. GAL.														
MINERAL OIL GAL														
KLEAROL GAL.														
SPREADER GAL.														

MONTH_____ DISTRICT INSPECTION AND TREATMENT REPORT

MMCD 3-76

COUNTY	INSPECTED	WET BREEDING	WET NOT BREEDING	DRY	GROUND LARVAL INSPECTIONS	GROUND ADULT INSPECTIONS	AIR LARVAL INSPECTIONS	AIR ADULT INSPECTIONS	PRE-HATCH INSPECTIONS	POST TREATMENT INSPECTIONS
ANOKA										
DAKOTA										
N. HENN.										
S. HENN.										
RAMSEY										
SCOTT										
WASH.										
DISTRICT TOTALS										

COUNTY	BIOLOGICAL CONTROL INSPECTIONS	SOURCE REDUCTION INSPECTIONS	GROUND LARVAL TREATMENTS	GROUND ADULT TREATMENTS	PRE-HATCH TREATMENTS	FF-9 TREATMENTS	600-700 TREATMENTS	AIR LARVAL TREATMENTS	AIR ADULT TREATMENTS	AIR PRE-HATCH TREATMENTS
ANOKA										
DAKOTA										
N. HENN.										
S. HENN.										
RAMSEY										
SCOTT										
WASH.										
DISTRICT TOTALS										

MONTH _____ DISTRICT INSECTICIDE USE REPORT (GROUND)

MMCD 3-76

COUNTY	GROUP 1 GROUND LARVACIDE								GROUP 2 GROUND ADULTICIDE														GROUP 3 GROUND P.H. & RESIDUAL					
	1 FUEL OIL TO 3 GAL PER ACRE		2 ABATE 1% 2.5 LBS. PER ACRE CELATOM GRANULE		3 MALATHION 12.5 FL. OZ. PER ACRE		4 ABATE 1% 5 LBS. PER ACRE CELATOM GRANULE		18.5%5 RESMETHRIN 1.5 FL. OZ. PER ACRE 25.6 OZ. PER GAL. F.S.		18.5%6 RESMETHRIN 8.1 FL. OZ. PER ACRE 9.3 OZ. PER GAL. F.S.		7		8 MALATHION 8.4 FL. OZ. PER ACRE		40% 9 RESMETHRIN 8.1 FL. OZ. PER ACRE 4.3 OZ. PER GAL. F.S		40% 10 RESMETHRIN 1.5 FL. OZ. PER ACRE 11.5 OZ PER GAL. F.S.		11		12 DURSBAN 1% 5 LBS PER ACRE SAND GRANULE		13 DURSBAN 1% 10 LBS. PER ACRE SAND GRANULE		14 DURSBAN 1% 5 LBS. PER ACRE CELATOM GRANULE	
	2 OR 4 GAL SPRAYER		SEEDER		HUDSON		SEEDER		COLD FOG		COLD FOG				HUDSON		HUDSON		COLD FOG				SEEDER		SEEDER		SEEDER	
	GAL.	ACRES	LBS.	ACRES	GAL	ACRES	LBS	ACRES	GAL	ACRES	GAL	ACRES			GAL	ACRES	GAL.	ACRES	GAL	ACRES			LBS.	ACRES	LBS	ACRES	LBS	ACRES
ANOKA																												
DAKOTA																												
N. HENN.																												
S. HENN.																												
RAMSEY																												
SCOTT																												
WASH.																												
DISTRICT TOTALS																												

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MONTH_____ DISTRICT INSECTICIDE USE REPORT (AIR)

MMCD 3-76

COUNTY	GROUP 4 AIR LARVACIDE												GROUP 5 AIR ADULTICIDE						GROUP 6 AIR PRE-HATCH AND RESIDUAL							
	16 ABATE 1% 5 LBS PER ACRE CELATOM GRANULE		17 ABATE 4 LB. 6 OZ PER ACRE 34 OZ. PER GAL. F.S.		18 DURSBAN 4 LB. 6 OZ. PER ACRE 17 OZ. PER GAL. F.S.		19 MALATHION 5 LB. 13 OZ. PER ACRE		20 ABATE 1% 7.5 LBS. PER ACRE CELATOM GRANULE		21		22 DURSBAN 4 LB. 10 OZ. PER ACRE 10.25 OZ. PER GAL. F.S.		23		24		25 DURSBAN 1% 5 LB PER ACRE CELATOM GRANULE		26 DURSBAN 1% 10 LB. PER ACRE CELATOM GRANULE		27 DURSBAN 4 LB. 6 OZ. PER ACRE 34 OZ. PER GAL. F.S.		28	
	LBS.	ACRES	GAL	ACRES	GAL	ACRES	GAL	ACRES	LBS	ACRES			GAL.	ACRES					LBS.	ACRES	LBS	ACRES	GAL.	ACRES		
ANOKA																										
DAKOTA																										
N. HENN.																										
S. HENN.																										
RAMSEY																										
SCOTT																										
WASH.																										
DISTRICT TOTALS																										

MONTH_____ DISTRICT MONTHLY INSECTICIDE USE AND ACRES TREATED COMPOSITE

MMCD 3-76

	TOTAL ACRES TREATED
GROUP 1 GROUND LARVACIDING	ACRES
GROUP 2 GROUND ADULTICIDING	ACRES
GROUP 3 GROUND PRE-HATCH AND RESIDUAL	ACRES
GROUP 4 AIR LARVACIDING	ACRES
GROUP 5 AIR ADULTICIDING	ACRES
GROUP 6 AIR PRE-HATCH AND RESIDUAL	ACRES

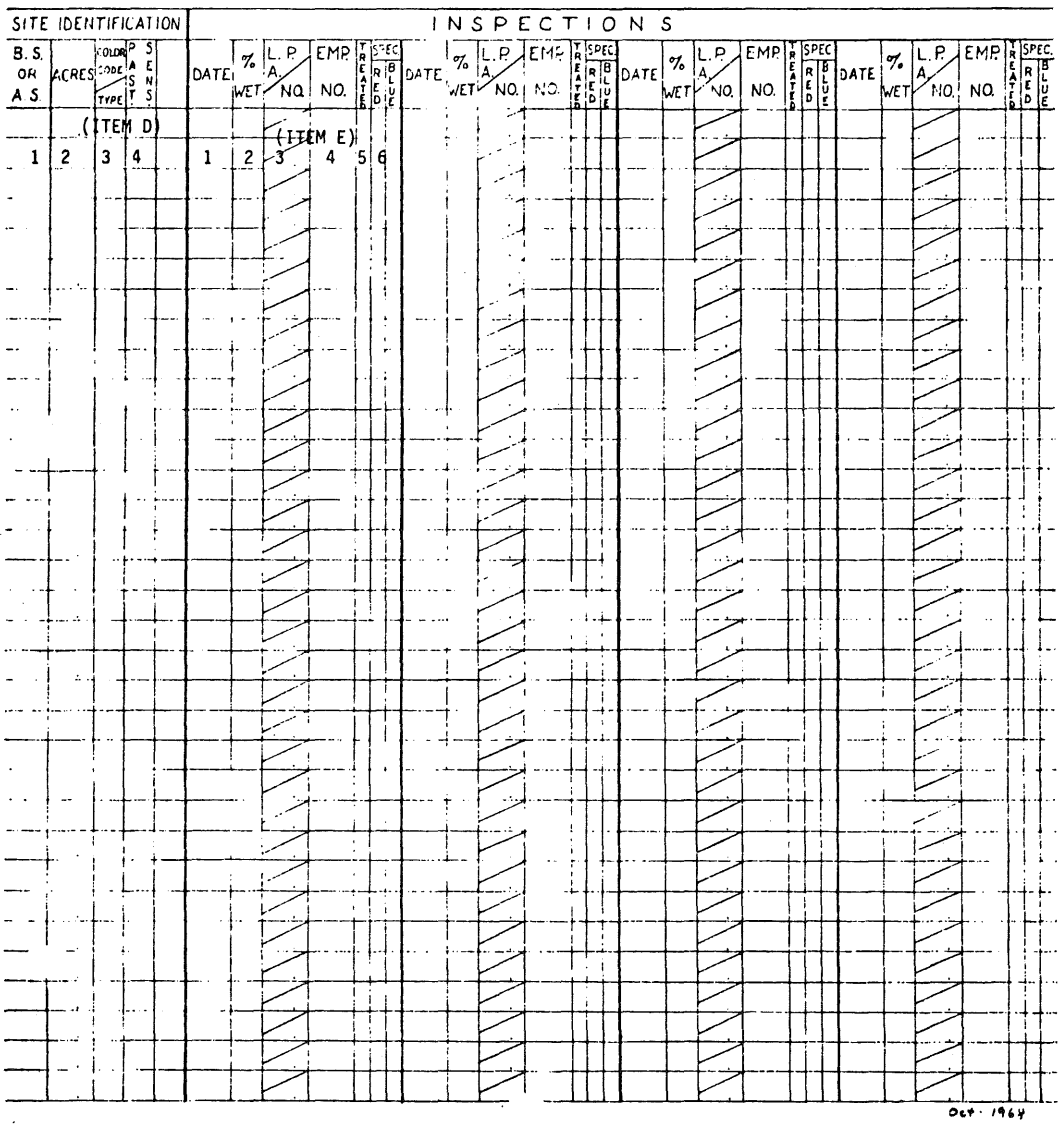
MATERIAL	TOTAL MATERIAL USED	
	SUPERVISORS INVENTORY	FF-2 TOTALS
1 FUEL OIL	GAL.	GAL.
2-4-16-20 ABATE 1%	LBS.	LBS.
12-13 DURSBAN 1% (SAND GRANULES)	LBS.	LBS.
14-15 DURSBAN 1% (CELATOM GRANULES)	LBS.	LBS.
8-19 MALATHION 5LB.	GAL.	GAL.
17 ABATE 4LB.	GAL.	GAL.
5-6 RESMETHRIN 18.5%	GAL.	GAL.
9-10 RESMETHRIN 40%	GAL.	GAL.
18-22-27 DURSBAN 4LB.	GAL.	GAL.
MINERAL OIL	GAL.	GAL.
KLEAROL	GAL.	GAL.
SPREADER	GAL.	GAL.

METROPOLITAN MOSQUITO CONTROL DISTRICT

B.S. and A.S. RECORD

1

COUNTY NO. 2 TOWNSHIP NO. 3 SECTION NO. 4 YEAR 5



e. i.

exhibit a.

MAJOR TECHNICAL CONTRIBUTORS

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Twin Cities Hydrology	Dr. Hans Olaf Pfannkuch University of Minnesota St. Paul, Minnesota
Twin Cities Climatology	Mr. Bruce Watson Meterological Consultant St. Paul, Minnesota
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Insecticide Allergies	Dr. Louis Enkema American International Hospital Zion, Illinois
Vertebrate Wildlife Toxicology	Dr. Maurice Provost Florida State Health Department Vero Beach, Florida
Invertebrate Aquatic Toxicology	Dr. Mir S. Mulla Department of Entomology University of California Riverside, California
Apiology	Mr. E. Laurence Atkins Department of Entomology University of California Riverside, California
Insect Bio-Control	Dr. Duane Biever Biological Control of Insects Laboratory USDA ARS Columbia, Missouri

Insecticide Resistance	Dr. George P. Georghiou Department of Entomology University of California Riverside, California
Residue Chemistry	Dr. Paul E. Lichtenstein Department of Entomology University of Wisconsin Madison, Wisconsin
Insecticide Registration Data	Dr. E. E. Kenaga Dow Chemical Company Research Department Midland, Michigan
	Dr. D. N. Byrne American Cyanamid Company Princeton, New Jersey.
	Dr. G. K. Schumaker S. B. Penick Company Orange, New Jersey
	Dr. Rizwanul Haque U. S. Environmental Protection Agency Washington, D.C.

CONCERNS REGARDING MOSQUITO CONTROL REFERRED TO THE M.M.C.D. FOR CONSIDERATION IN ITS EIS BY STATE AGENCY PERSONNEL AND CITIZENS ORGANIZATIONS

In the spring of 1976, the Minnesota Environmental Control Citizens' Association and five state agencies submitted the following lists of concerns for consideration by M.M.C.D. in its Environmental Impact Statement.

A. Mecca

We agree with the concerns expressed by the other agencies and wish to emphasize the following:

1. Development of immunity in target organisms, and the epidemiological consequences of loss of control due to immunity factors

2. Selectivity of pesticides; impact on non-target species, terrestrial or aquatic; secondary impact through the food chain

3. Biological magnification potential of chemicals

4. Validity of EPA ratings

5. Maximum information on all chemicals used, where used, and under what conditions

6. Environmental impact of dispersal agents (oil, diatomaceous earth, etc.)

7. Potential health impact on human population from single large dose or long-term low level exposure; health impact on pesticide-sensitive persons (allergenic reactions)

8. Synergistic effects of combinations of pesticides employed; and of combinations of pesticides with non-pesticide chemicals, e.g., medications, air pollutants, water pollutants

9. Consideration of impact and alternative controls or of no controls at all

10. Economic impact of loss of pollinating insects on agricultural and wildlife strains

11. Cost-effectiveness of program--is the public getting any tangible benefit?

12. Impact of noise and the presence of men and equipment on domestic animals and wildlife (e.g., cattle, nesting fowl, etc.)

13. Discussion of how policy decisions are made regarding the designation of sensitive/insensitive areas

14. Policy channels for spraying public lands under control of other state, federal or local agencies (e.g., DNR, Minneapolis Park Board)

15. Social impact of privacy-invasion--effectiveness of "no-spray" request

16. Adequacy of label instructions--what assurance that they are followed

17. Who supervises actions of field workers? With what consistency?

18. Chart management effectiveness of Metropolitan Council/M.M.C.D. relationship (Don Skinner, President)

B. Minnesota Department of Health

Health Consequences of No Mosquito Control.

1. Incidence of Encephalitis

2. Nuisance of mosquito bites.

3. Sensitization reaction of some individuals to mosquito bites

4. Limitations on outdoor recreation (exercise and mental health)

5. Effects of increased private mosquito control (repellent applied to person or private property)

Health Consequences of Chemical Mosquito Control

1. Toxicity to the general public

   a. Acute one-time exposures

   b. Chronic long-term exposures

   c. Adequacy of EPA and state regulations regarding toxicity classification, use restrictions, application dose rates, and applicator training

2. Toxicity to M.M.C.D. applicators (occupational exposures)

3. Contamination of drinking water and food supplies

4. Contamination of recreation waters (swimming)

Health Consequences of Other Mosquito Control Methods

1. Contamination of ground water by drainage techniques

2. Site effects of biological controls (Frederick Heisel, Director - Division of Environmental Health)

C. Minnesota Department of Natural Resources

1. Types and specific amounts of chemicals used and their status with EPA

2. Toxic potential to wildlife of insecticides, particularly Dursban and the chlorocarbon residues of its breakdown products

3. Effects of dispersal methods, particularly the effect of emulsifiers on penetration capability of larvacides and insecticides.

4. Possible potentiation of wildlife from exposure to more than one organophosphorous insecticide; also the minimum time span between spraying or applications

5. M.M.C.D. practices used in roadside ditches --effect of insecticide application on nesting and hatching birds and their eggs

6. The problem of biological magnification of insecticide residues up through the food chain

7. The effect of insecticides on non-target organisms, particularly in regard to their reproductive capability

8. Consideration of the action of farmers, private recreation areas, and private landowners in applying insecticides and the relationship of such applications to M.M.C.D. programs (i.e., is M.M.C.D. notified, etc?)

9. Effectiveness of the program in mosquito reduction

10. Alteration of wetlands and the associated impacts, especially of any proposed drainage. Effects of mechanical or engineering control of mosquito sources on wildlife habitat availability. DNR is particularly concerned with this proposed means of control. If alteration of wetlands is an alternative that M.M.C.D. plans to use, it should be treated in some detail in this EIS (Vonny Hagen, Environmental Review Coordinator)

D. Minnesota Department of Agriculture

1. Type and amount of training received by the insecticide applicators and supervisory personnel

2. Methods of insecticide applications used by the District

3. Types of equipment used by the District

4. Controls used within the organization to assure compliance with:

   a. The law and license requirements

   b. Accepted methods of insecticides application and label directions for use

   c. Training of personnel

   d. Maintenance of equipment

   e. O.S.H.A. standards

5. Means of monitoring to determine the actual dosages of insecticides applied and means of assuring that the equipment is calibrated to assure proper dosages

6. Means of citizen inputs into the operation of the program

7. Precautions taken to protect the environment, individuals, and real property in the application of insecticides

8. Safeguards used in the use, transportation, and disposal of insecticide containers to prevent possible contamination of individuals and the environment

9. Mechanism used for review of the affected governmental agencies

10. Means used by district personnel to remain current on new methods and techniques, scientific advances in the field, etc.

11. Possible long-term effects of continued use of insecticides upon the environment

12. The effectiveness of the program in controlling mosquitos

13. Alternative methods of controlling mosquitos and their effectiveness (Randall Young, Senior Management Analyst)

E. Minnesota Pollution Control Agency

1. A study should be conducted on Water Quality effects resulting from implementation of the proposed mosquito control program. Such a study should include:

   a. A monitoring program on a wetland surface water/ground water

   b. A valid "control" which would require premonitoring of the test area and control

2. Plant and animal bioassays should be conducted on all biocides used in the mosquito control program. This should include study of acute and chronic effects. This would include natural as well as synthetic biocides

3. A study should be made on the effects of any biocides used in the mosquito control program on non-target organisms including plants as well as animals. This study should also examine the possibility of biomagnification of a given biocide through the food chain of selected aquatic as well as terrestrial organisms

4. A study should be made on soils which have been heavily treated with one or more biocides. This should include chemical and biocide testing of the soil to determine biocide concentration

5. A study should be done to evaluate the possibility of potential for developing mosquito immunity to a given biocide

6. Greater emphasis should be placed on implementing an integrated pest control program rather than relying heavily on the unilateral chemical approach, namely pesticides in ever increasing amounts. This effort should not be limited to permanently wet areas but should include temporary wet areas as well

7. An empirical method should be developed to show quantitatively how not treating a given area with a biocide increases the numbers of mosquitos in that area; if this cannot be implemented then the M.M.C.D. should honor requests by property owners who do not want their property treated for whatever reason

8. In areas where there is a potential for run-off of water containing a biocide or percolation of such a biocide into the ground water a study should be conducted to assure that MPCA Water Quality Regulations are not being violated

9. A study should be conducted on Air Quality effects resulting from pesticide use in connection with the M.M.C.D. Mosquito Control Program. Such a study should include:

   a. Monitoring program in the target area, i.e., where the biocides are applied giving a direct quantitative indication of actual concentration presents after a given application

   b. A valid "control" which would require premonitoring of the treated area and the "control" area

10. M.M.C.D. must indicate specifically how pesticide containers will be disposed of after use and also how unused portions of biocides will be disposed of

11. A study should be conducted specifically focusing on the kind and amount of residue in the soil and vegetation and also on the biodegradability of biocides used and the potential for a resynthesis of the biocide, after biodegredation, into a different variety of toxic compound (Dr. Edward Pryzina, Division of Water Quality)

F. Minnesota Energy Agency

1. What has been the historical use of fuel oil in pupa control by the M.M.C.D.?

2. What are projections for the future use of fuel oil for pupa control?

3. Where and how is fuel oil applied?

4. How effective is fuel oil as a pupacide?

5. What is the toxicity of fuel oil to non-target organisms?

6. What is the estimated fuel consumption for aerial applications of insecticides?

7. How much petroleum is used as a carrier for insecticides? (Karen Cole, Environmental Coordinator)

QUESTIONS REFERRED TO SCIENTIFIC EXPERTS IN AN EFFORT TO DETERMINE PROBABLE ENVIRONMENTAL IMPACTS OF ALTERNATE MOSQUITO CONTROL PROGRAMS

Each transmittal forwarded to scientific experts was prefaced in the following manner:

> "From the background on the Metropolitan Mosquito Control District program and the ecological description of the Twin Cities area, please respond to the following questions based on your knowledge of the technical literature and personal experience with a 'State of the Art' statement, providing a brief summary of relevant current pro and con data, citing pertinent literature reference." (M.M.C.D. 1976)

Questions referred to these scientists were selected in cooperation with Minnesota State Agencies represented on the MEQC and MECCA.

A. Twin Cities Ecology (Dr. Daniel Huff)

1. For each type of physical site modification listed under control program alternatives in Phase I of the EIS, what would be the expected impacts of each on wildlife and upland and marshland ecosystems (include plant communities)?

2. What is the impact of the District program on domestic animals and wildlife in regards to noise and the presence of men and equipment?

3. What suggestions do you have for reducing the above impacts in the District program?

B. Twin Cities Hydrogeology
(Dr. Hans Olaf Pfannkuch)

1. What would be the expected impacts of the physical site modification listed under

control program alternatives in Phase I of the EIS, upon the upland and marsh hydrogeology?

2. What would be the expected impacts on the hydrologic cycle, including groundwater and downstream watershed effects, of applying limestone to temporary water depressions located above the ground water level?

C. Twin Cities Climate (Bruce Watson)

No specific request beyond a general summary of local climate features.

D. Pesticides - chlorpyrifos (Dr. E.E. Kenaga)
temephos (Dr. D.N. Byrne)

The following questions were asked of the technical representative of each respective material:

1. What acute and chronic environmental hazard do the dosage rates and insecticide formulations used in the District program pose for vertebrate wildlife? Please include information relative to effects on reproductive capabilities of vertebrate wildlife including nesting birds, eggs and young.

2. What would be the expected secondary impacts of their use on wildlife via food chains?

3. What are their degradation products? Are they known to be detrimental singularly or in combination with other environmental components? How long do the breakdown products persist? Does the insecticide itself or any of its breakdown products undergo biological magnification?

4. What synergistic effects with other pesticide or non-pesticide chemicals used in the United States are known? Please emphasize any relationship which may exist to air and water pollutants such as hydrocarbons, SO_2, CO, PCB, etc.

5. What are the effects of soil type on residue life?

6. What are the expected impacts from their application on humans and wildlife when applied ULV at 6 fl. oz/acre, 1% granules and 5 gallons per acre water emulsion applications at dosage rates registered for mosquito control, and at double those rates? Response is requested for 5, 20, and 40 foot exposures from discharge point.

7. What evidence is available on the long term human consequence of continuing applications on a ten application per season interval?

8. What are the known impact effects and their duration on vertebrate and invertebrate non-target organims?

The United States Environmental Protection Agency was asked to respond to the following questions.

1. What are the degredation products of the insecticide temephos Malathion, chlorpyrifos, Resmethrin and Pyrethrum used by the District? Are they detrimental to the environment? If so, which insecticides, and how long do their breakdown products persist?

2. Do any of the insecticides or breakdown products used by the District undergo biological magnification in the environment.

3. Are any of the insecticides used by the District known to exert synergistic effects on other pesticide on non-pesticide chemicals used in the United States? Please place emphasis on air and water pollutants such as hydrocarbons, SO_2, CO, PCB, etc.

4. Do the insecticide formulations (less toxicant) have a detrimental effect on the environment (surfactants, granules, oil, etc.)?

5. What is the potential for resynthesis of the insecticides used by the District?

6. What is the effect of soil type on the residue life on insecticides used by the District?

E. Apiology (Mr. Laurence E. Atkins)

1. What would be the expected impacts and their durations, of the insecticide formulations used in the District program on honeybees? Other pollinating insects? Please include known food chain magnification, effects on reproductive capability and impact of carriers.

2. What potential impact would the use of controlled release Abate or Dursban larvicide formulations applied once/year, in place of the average of 6 larvicidal treatments/year, have on pollinating insects?

3. What suggestions do you have for reducing the above impacts in the District program?

4. Please reference documentary evidence you are aware of which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District.

F. Insecticide Allergy (Dr. Louis Enkema)

1. What would be the expected intensity of allergic reaction in allergic individuals, and their durations, of each of the insecticide formulations used in the District program? Please rank the formulations used from most to least likely to induce reactions

2. In place of 6 larvicidal applications/year, what different impact would the application once per year of Abate or Dursban controlled release larvicide pellets, which release when flooded have on allergic individuals?

3. What percent of a normally distributed human population exhibits allergic reactions to contact with the above insecticides.

4. Please reference documentary evidence you are aware of which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District.

G. Invertebrate Aquatic Toxicology (Dr. Mir. S. Mulla)

1. What would be the expected impacts and their durations, of the insecticide formulations used in the District program on aquatic invertebrate non-target organisms? Please include known food chain magnification, effects on reproductive capability and impact of carriers.

2. What potential impact would the use of controlled release Abate or Dursban larvicidal formulations applied once/year, in place of the average of 6 larvicidal treatments/year, have on aquatic invertebrate non-target organisms?

3. Please reference documentary evidence you are aware of which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District.

H. Vertebrate Wildlife Toxicology (Dr. Maurice Provost)

1. What acute and chronic environmental hazard do the dosage rates and insecticide formulations used in the District program pose for vertebrate wildlife?

2. What effects do these insecticides have on the reproductive capability of vertebrate wildlife, including nesting birds, eggs and young?

3. What is the relationship between the chemicals and dosage rates used in the District program and those used in agriculture with regard to hazard to wildlife? What is the expected impact of overlaping agricultural and District treatments on wildlife in wetlands immediately adjacent to farm lands?

4. What would be the expected secondary impacts of the District insecticide use on wildlife via the food chain?

5. In place of 6 larvicidal applications/year, what different impact would the application once/year of Abate or Dursban controlled release larvicide pellets which release when flooded, have on each of the above questions?

6. Please reference documentary evidence which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District.

I. Human Toxicology (Dr. Wayland I. Hayes, Jr.)

1. What are the expected impacts of insecticide formulations used by the District on humans from a single application at the dosage rates registered for mosquito control, and at double those rates?

2. What are the expected long-term human consequences of continued use of the insecticide formulations presently used by the District?

3. What would be the expected impact of the insecticide formulations to pesticide-sensitive (allergenic reactions) individuals? Their frequency?

4. What would be the expected human hazard associated with the use of fuel oil (diesel) when used as an insecticide carrier for aerial applications at 6-10 ounces/acre, and when sprayed by hand at 3 gallons/acre?

5. What is the expected potential of the insecticide formulations used by the District to synergize other pesticides or non-pesticide chemicals?

6. Do you feel the Environmental Protection Agency regulations pertaining to mosquito control formulations used by the District and their respective dosage rates are adequate? Why?

J. Biological Insect Control (Dr. Duane Biever)

1. What are the expected impacts and their durations, of the insecticide formulations used in the District program on invertebrate terrestrial non-target organisms? Please include known food chain magnification, effects on reproductive capability and impacts of carriers

2. What potential impact would the use of controlled release Abate or Dursban larvicidal formulations applied once/year, in place of the average 6 larvicidal treatments/year, have on invertebrate terrestrial non-target organisms? Would the impact be greater or less?

3. What are the expected negative impacts of the proposed use of biological control agents in the District program?

4. Please reference documentary evidence you are aware of which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District

K. Insecticide Residue Chemistry (Dr. Paul E. Lichtenstein

1. What are the degredation products of the insecticides Abate, Malathion, Dursban, Resmethrin and Pyrethrum used by the District? Are they detrimental to the environment? If so, which insecticides, and how long do their breakdown products persist?

2. Do any of the insecticides or breakdown products used by the District undergo biological magnification in the environment?

3. Are any of the insecticides used by the District known to exert synergistic effects on other pesticide or non-pesticide chemicals used in the United States? Please place emphasis on air and water pollutants such as hydrocarbons, SO_2, CO, PCB, PAN, etc.

4. Do the insecticide formulations (less toxicant) have a detrimental effect on the environment (surfactants, granules, oil, etc.)?

5. What is the potential for resynthesis of the insecticide residues after degredation into a different variety of toxic compound?

6. What is the effect of soil type on the residue life on insecticides used by the District?

7. What different impact would the application once/year of Abate or Dursban controlled release larvicide pellets which release when flooded, have on each of the above questions?

L. Insect Resistance (Dr. George P. Georghiou)

1. Under the conditions existing within the District (i.e., number of generations/year,

mixing of controlled with uncontrolled populations of multivoltine species, etc), what would be the expected time frame for the development of an operationally limiting level of resistance from a continuation of the present program? If the present 14 mile radius larval program were doubled to 28 miles?

2. Culex tarsalis, the vector of Western and St. Louis Encephalitis, is a species which receives control emphasis only during years the population comprises over 5% of the light trap collections. On normal years (1966 - 74) the incidence of C. tarsalis females in light traps averaged 1% of all collections, in larval collections the species was identified in 4.1% of all samples. Under these conditions what would be the expected time frame for the development of an operationally limiting level of resistance in this species?

3. What potential impact would the use of controlled release Abate or Dursban larvicide formulations applied once/year, in place of the average of 6 larvicidal treatments/year, have on the development of operationally limiting levels of resistance within the District?

4. What suggestions do you have for reducing the potential for developing resistance in the District program?

5. Please reference documentary evidence you are aware of which substantiates or discredits the validity of EPA regulations pertaining to the mosquito control formulations and dosage rates used by the District.

exhibit b.

EFFECTIVENESS ANALYSIS

In its final report, the Pesticide Task Force (1976) of MEQC reiterates two of the concerns raised by the Minnesota Environmental Control Citizens Association (MECCA) in its successful petition to the MEQC which resulted in the preparation of this EIS:

1. Control programs based upon these chemicals (i.e., insecticides) tend to result in successive generations of insects increasingly resistant to the chemical insult received;

2. The MMCD has in fact failed to control mosquitos, resulting in large expenditures of public tax funds at no significant benefit to the taxpayer.

At base in both items is an extremely valid question about the cost-effectiveness of a major Metropolitan agency. The first concern has been addressed elsewhere in this report, the second concerns this section.

The demonstration that insecticides as used in the MMCD have not induced resistance demonstrates the effectiveness of these chemicals on a site-by-site basis.

It does not necessarily follow that the District's program has been successful in lowering the mosquito populations over the entire District to a point where their annoyance to humans is noticeably reduced. To put it another way, it does not necessarily follow that technical knowledge implies operational success.

Primary research into the effectiveness and meaningfulness of the District's operations received a good deal of attention in the preparation of this report. The ability of the program to significantly reduce mosquito populations was examined through a series of investigations.

None of these measurements in and of itself is a sufficient indicator of the District's performance. Together they provide a reasonably complete picture of what occurs and some indications for future operations.

A short description of each, together with its potential, methodological problems, and contribution is provided below as an overview of the nature of research in this topic area.

1. Relative changes in mosquito control are defined as those per cent differences between mosquito counts in low population months vs. high population months. Effective mosquito control should result in less relative growth in controlled areas vs. uncontrolled areas. This is a fairly strong tool, but it suffers from two problems:

   a) To the extent the District is very successful during low mosquito density time, it will be shown to be unsuccessful by this measurement. This is especially true if mosquito counts during lower times are quite small.

   b) If, during high production times, prevailing winds carry mosquitos from outside a 15-mile radius, the effectiveness measure will be inaccurate as an overall indicator.

   In general, then, the measurement can be used as an indicator, not a parametric examination. Generally, for the reasons described above, it will be conservative as a measurement of the per cent elimination of mosquitos. Its analysis will be limited to years of average mosquito production.

2. Absolute differences in mosquito counts is defined as light-trap count differences between controlled and uncontrolled areas. The rationale is to show how many fewer mosquitos exist within the District as opposed to outside the District. This can also be a strong tool, but suffers from the fact that breeding site density - and hence mosquito breeding - is greater outside the built-up area that the District serves.

   Even given in-flights of mosquitos, this measure tends to exaggerate mosquito control effectiveness.

3. Changes in outdoor time denied by different levels of mosquitos are found by obtaining resident responses to these different levels. Research was conducted in 1976 to determine these levels.

   This is a valuable tool since it allows us to calibrate the meaning of control in the lines of residents. Two problems with the research remain, however:

   a) Since 1976 was the record low year for mosquitos, residents tended to ignore mosquito annoyance. This systematically lowers the response to mosquito populations.

b) No upper threshold levels of mosquitos were found. By "threshold" is meant that level that causes a rapid increase in denied time.

Use of this tool, in conjunction with either 1 or 2 above renders any analysis of historical effectiveness conservative in its estimates.

4. Assistance to public recreation areas provides a measurement of the effectiveness of adulticiding. Park supervisors were asked about changes in user rates occasioned by the District operation. The sample was small, but the results were indicative of a fairly well-received program.

5. Changes in private cost of mosquito control were measured as responses to different levels of mosquito activities in the summer of 1976. This measurement has similar strengths and problems to those described above under changes in outdoor time denied.

6. Current control costs are 80¢ per capita. Research to find out actual value of control was somewhat hampered by relatively low response rates; it is otherwise a good measure of value rather than cost.

7. Opinions from respondents in a 1976 survey were taken on both observed effectiveness and the willingness to have more funds allocated for a better control program. Joined with other analyses above, they complete the picture. Alone they tend to lack a sufficient meaning.

ANALYSIS ONE: RELATIVE CHANGES IN MOSQUITO CONTROL

First, an important methodological note about light traps must be made. Light traps as used by the MMCD were designed to give county control supervisors a handle on changes in mosquito populations over time. Thus they were not designed as measurements of overall effectiveness, but rather as a systematic guide to day-to-day operations in local areas. Local variability is so much a factor that variations between light traps as traps may be as important as variations in breeding capacities near traps.

A crucial assumption, nevertheless, is that the light trap populations are representative of the changes over time of mosquitos bred in a given geographical area. This, indeed, is their operational use. Given this assumption, one can standardize light trap populations across time, as long as one does not directly compare populations of different traps.

Light traps that were considered for this analysis are shown in Figure XV in the main text.

The amount of change in mosquito counts between times of high counts vs. times of low counts is one measurement of effectiveness. Theoretically, the change should be less within the controlled area, since larviciding should prevent mosquito populations from growing as fast as they do in uncontrolled areas.

Table EI-1 shows light trap counts of female mosquitos in average years for controlled vs. uncontrolled areas. Average years were set in terms of rainfall. The average annual rainfall for the thirteen years 1959-1971 was 18.96 inches. The proximity to that average for the five selected years is as follows:

1960	+ 1.15 inches
1961	- 2.40 inches
1964	- 2.11 inches
1970	- 1.41 inches
1971	- 1.14 inches

Comparing the average change in light trap counts of controlled vs. uncontrolled areas shows that controlled traps had an average of 2.54 times as many mosquitos in high count months as in other months.

Other areas had 3.63 times as many mosquitos in high count months as in other months. Uncontrolled areas thus showed 143% more increase than controlled areas.

A problem with this analysis can readily be seen from the table. Controlled counts are so low in an absolute sense that count changes could be a result of such factors as refused entry locations or light prevailing winds. Thus, the figures above are probably conservative.

Table EI-1

Light Trap Counts for
Average Years (1960, 1961, 1964, 1970, 1971)

Trap No. Controlled Traps	Average Night Counts		Ratios of worst month to other months
	Worst Month	Other Months	
1	42	16	2.62
3	51	21	2.43
Uncontrolled Traps			
4	104	29	3.59
5	59	21	2.81
7	501	161	3.11
9	105	21	5.00
10	163	42	3.88
12	176	37	4.75
14	311	117	2.66
15	126	43	2.93
16	771	196	3.93

ANALYSIS TWO: DIFFERENCES IN ABSOLUTE COUNTS

Light traps have generally been difficult to directly compare because, as noted above, large differences between placement situations renders comparisons unreliable. Since what is ultimately important to the District is the relationship between traps and residential discomfort, eight light trap[1] populations were compared to landing counts in neighborhoods near the traps for six observations. The following results occurred:

[1]District manpower requirements to deal with the peak of the mosquito season, including suppression of the disease vector, Culex tarsalis, prevented measurements at other trap locations.

Table EI-2

Light Trap Standardization

Trap No. Controlled	Average Light Trap Counts	Neighborhood Landing Counts	Trap Landing (ratio)	Relationship Trap #1
1	17.0	.5	34.0	1.0
3	49.9	.8	62.0	0.5
Uncontrolled				
2	4.0	2.8	1.4	24.3
4	97.3	11.4	9.0	3.8
5	39.3	10.4	4.0	8.5
9	12.6	.8	16.0	2.1
10	3.8	3.3	1.0	34.0
16	96.3	7.1	14.0	2.4

Since traps 2 and 10 are based on extremely low light trap counts, relative to their history, they will not be included in further analysis.

The next step is to evaluate the past mosquito production of controlled areas compared to uncontrolled areas.

This is done in the following table for all years and for the average years indicated above.

Table EI-3

Standardized Female Mosquito Counts

Light Trap No. Controlled	All years' average		1960,1961,1964,1970,1971 Average	
	Worst Month	Other Months	Worst Month	Other Months
1	64.0	16.7	41.8	15.7
3	53.0	14.6	28.9	11.7
Average	58.5	15.6	35.4	13.7
Uncontrolled				
4	974.4	180.8	414.2	117.4
5	794.6	197.9	531.0	185.6
9	222.7	47.7	213.4	42.8
16	2752.6	578.8	1928.6	612.0
Average	1185.0	251.0	771.8	239.4
Controlled/ Uncontrolled	.049	.062	.037	.057

Note to Table EI-3: Most uncontrolled trap locations tend to have collector zones that overlap into the controlled area, which lower their counts somewhat. These overlaps have been disregarded for purposes of this analysis. See Figure XV in the main text for examples of overlap.

On an average, the number of female mosquitos in the Minneapolis/St. Paul area is 3.7%-6.2% of the number in uncontrolled areas. Before concluding that the program is 93.8%-96.3% effective, however, one needs to compare the breeding potential of the areas around each of the six light traps.

Clarke (1943) showed that the principle pest species, Aedes vexans, had a dispersion zone of 15 miles. By the same token, any point (such as a light trap) collects A. vexans from an area of about 15 miles radius.

Table EI-4 summarizes these relationships:

TABLE EI-4

Mosquito potential by distance from trap

Distance from breeding sites to trap		Proportion of light trapped mosquitos	
band width (mi.)	band area (sq. mi.)	overall	per sq. mi. of band
0-3	28.3	.215	.00761
3-6	84.7	.117	.00138
6-9	141.3	.180	.00127
9-12	197.9	.279	.00141
12-15	254.3	.209	.00082
	706.5	1.000	

Source: Clarke, 1943

As stated above, it is necessary to standardize the light trap populations according to breeding capacities of the area they represent. In the Environmental Setting, three types of sites were distinguished:

Type I sites, which are small intermittent sites which are assumed to produce six broods of mosquitos in an average year, each assumed to last half of the season.

Type II sites, which are small intermittent sites which produce one brood of mosquitos a year, each assumed to last the entire season.

Type III sites, which are more or less permanent water sites which are assumed to produce six broods of mosquitos a year, each assumed to last half the season.

Since variance between different areas is more a function of total acreage than different types of sites, Type I sites will be used for comparison purposes.

This calibration will be done for the three mile area around each trap, the most crucial contributing zone. Table EI-5 lists acreages for each light trap collection zone.

TABLE EI-5

Mosquito Breeding Potential of Selected Type Collection Zones

Light Trap No. Controlled	No. of Active Type I Acres
1	621
3	2,003
Average	1,312
Uncontrolled	
4	2,761
5	3,195
9	1,523
16	4,714
Average	3,048
Uncontrolled/controlled	2.32

Effectiveness of treatment of the center, in average years (entire season) is this: 100% - 2.32 (5.8%) = 86.6%. This number is crucial to the rest of the analysis, since light trap counts in the center will be adjusted to show their levels without control.

On an average, the mosquito population in light traps in the central cities would have been at a rate of 443 mosquitos per night during the worst month, and 94 during the other months. On a seasonal basis, then, there is a difference of 180 mosquitos per evening.

This is because the outside trap populations averaged 1,185 female mosquitos during the worst month (Table EI-3), they

have 2.32 times as many breeding sites (1185/2.32 = 510.8) and the District is shown to be 86.6% effective (510.8 X .866 = 442). By a similar analysis, the other two months would have 94 (251/2.32 X .866 = 94).

On an average $\left(\frac{2 \times 94 + 442}{3}\right)$, there would have been 210 mosquitos each evening. There were actually 30 (see Table EI-3) $\left(\frac{2 \times 15.6 + 58.5}{3} = 30\right)$. Thus, 210 - 30 = 180.

A CORRELATION BETWEEN LIGHT TRAP DATA AND BITE COUNTS

Before human behavioral reaction analysis can be done, however, a technical problem remains. There are two basic methods of counting mosquitos. One is the light trap method discussed above. The other is a 5 or 15 minute biting test. These are done by human recorders who catch mosquitos as they land on the upper body. (See p. es-60 ft. above.)

Since bite counts were used to provide recordings for correlation with household survey items, another investigation which proved crucial to the analysis was discovering the relationship between changes in light trap data (ΔLT) and changes in five minute bite count data (ΔB_5).

Review of previous research had not yielded formulae. Our research, which was limited to A. vexans comparisons, showed a strong correlation (.497) significant to the .001 level, which yielded a regression formula for fifteen minute bite counts.

The analysis proceeded as follows:

MOSQUITO REDUCTION IN PREVIOUS YEARS

1. Mosquito light trap counts have occured simultaneously with 15 minute bite counts in 413 instances from 1969 to 1973.

2. Large light trap collections are thought to result in poor bite count data, due to the heavy annoyance caused by the mosquitos to the collector. Examination of scatterplots of light trap to bite counts

revealed that light trap counts of over 200 caused a scattered and random pattern of response. These, (numbering 35), were excluded from the analysis. The resultant number of observations was limited to 378.

3. Only Aedes vexans were included in the analysis.

   a. Aedes vexans is the most frequently controlled species in the MMCD, and

   b. Each species is thought to have a different bite count/light trap relationship.

4. The resultant correlation between 15 minute bite counts and light traps was found to be .497 and significant to the .001 level. Since the correlation was sufficiently high, a regression equation was derived. This is given by 15 minute bite count = .099 (Light trap) + 1.718 , with the 95% confidence level = $\pm$ .018 (Light trap) + .84 for the correlation formula.

5. For differences between two 15 minute bite counts (ΔB_{15}) the equation reads:

   ΔB_{15} = .099 (ΔLight trap), with the 95% confidence level = $\pm$ .018 (Light trap).

6. For differences between two 5 minute bite counts (ΔB_5), the equation reads: $\Delta B_5 = \frac{\Delta B15}{3}$

7. For purposes of this analysis, .099 is approximated to .1, or 1/10, and the resultant analysis is $\Delta B_5 = \frac{\Delta LT}{30}$ with 95% confidence level of $\pm$ .006 (ΔLight trap).

ANALYSIS THREE: IMPACTS OF EFFECTIVENESS ON LEISURE TIME

As most people know, mosquitos are especially abundant in the evening hours. Unfortunately, this is a favorite time of day for adults to be outside. In most part, this is due to daytime occupational duties. With daylight savings

time, relatively hot days and the long evenings characteristic of northern climates, evenings provide the best and most available outdoor time for adults.

A survey conducted during the summer of 1976 developed the varying responses citizens gave to that summer's mosquito population.

Experimental mosquito count data for correlations with population reactions were gathered by the Metropolitan Mosquito Control District in the summer of 1976, in the form of five minute bite collections, in the same tracts where residential populations were interviewed.

The primary purpose of the twin studies of mosquito counts and population behavioral responses was to identify annoyance levels. These levels were defined as levels of denied outdoor activity time. It was found that adult time was far more sensitive than children's time.

The first analysis task was to specify in what way residents' actual denied time most closely correlated with their perception of mosquito annoyance. Responses to the statement "Mosquitos have been a bother during the last month", were correlated with ideal time desired, denied time, and percent denied time. The first was provided directly by the questionnaire, the second by the formula:

$$\text{denied time} = \text{ideal time} - \text{actual time},$$

and the third by,

$$\text{percent denied time} = \frac{\text{denied time}}{\text{ideal time}} \times 100$$

The best indicator was percent denied time, probably because this involved a simple transformation of the data which provided less variance than other measures. The results, significant to the .001 level, indicated that this indicator would be reliable as a correlation with mosquito counts.

Changes in percent denied adult (ΔPA) was found to have .44 correlation with changes in five minute mosquito bite counts, with a regression equation of $PA = 2.26\ (B_5) + 16.49$ or $\Delta PA = 2.26\ (\Delta B_5)$, where ΔA is the change

in percent adult time denied and ΔB_5 is the change in a five minute bite count.

The 95.0 percent confidence level is given by the formula:

(.82) Bite Count + 8.15 = percent denied time
and
(3.57) Bite Count + 20.67 = percent denied time

While these formulae must be regarded as only first steps in the evaluation of mosquito annoyance related to denied time, due to the unusually low range of mosquito activity in 1976, it can readily be seen that they will be conservative in their estimate of mosquito control effectiveness.

Persons experiencing no bites (and therefore no denied time) will be still recorded as having been denied 12.31% of their outdoor activity by mosquitos. The 90% denied time level is likewise high, about 50 bites, or a light trap count of some 1500 female Aedes mosquitos in a single night.

In any case, this formula will be extremely helpful in evaluating the importance to residents of mosquito control. See Table EI-6 for annual benefits.

ANALYSIS FOUR: MOSQUITO CONTROL IN PUBLIC RECREATION AREAS

To be effective, a program of mosquito control in recreation areas must perform a needed service, be relatively unnoticed by park users, and enjoy the general confidence of those being served. General coordination must be close enough to insure timely and effective service. There are, of course, funding limitations to accomplish this purpose. Guidelines for adulticiding reflect this fact.

Forty recreational administrators were interviewed in August 1976. Thirty-two administered areas that were receiving MMCD treatment; eight received no treatment.

Of the thirty-two receiving treatment, 25 (or 78%) had reported that mosquitos had been a problem in the past. Half of those not receiving spraying reported this. Of the first group, 88% thought a mosquito program desirable, 3% thought not, and 9% did not answer.

TABLE E1-6

Impacts of Current Program

	Home Populations					Impacts	
	A	B	C	D	E	F	G
	# Households	# Adults	% Contr.	Mosquitos Occurring	#Contr. per 5 min. bite count	Leisure hrs. Provided (1,000 hrs.)	Cost Reduc. Thous. of $
Interior	305,358	614,717	86.6	7	6.0620	12,938	633.49
Ring 1 Suburbs	186,126	372,252	65.0	9.57	6.2183	9,536	397.83
North	66,788	133,576	65.0	10.08	6.5520	3,566	148.78
South	49,352	98,703	65.0	8.54	5.5510	2,232	93.14
West	69,986	139,973	65.0	10.08	6.5520	3,737	155.91
Ring 2 Suburbs	117,798	235,596	43.0	11.62	4.9966	5,050	210.69
North	56,922	113,844	43.0	13.16	5.6588	2,625	109.52
South	22,266	44,533	43.0	10.08	4.3344	786	32.81
West	25,450	50,900	43.0	13.16	5.6588	1,173	48.97
East	13,160	26,319	43.0	10.08	4.334	464	19.39
TOTAL	611,282	1,222,565				27,526	1,242.01

CALCULATION NOTES FOR TABLE EI-6

Column	Calculation Note
A.	Source: Metropolitan Council Population Estimates, 1976.
B.	Column A x 2.
C.	Percent controlled is assumed to be a function of distance from the center. At the center it is 86.6%, at the edge of the district it is 43.3%, since only half the area is controlled. A middle distance is the average of these two, or 65%.
D.	Areas of greatest mosquito intensity are to north and west. Thus, mosquito counts at suburb locations to the north and west are assumed to have higher natural values. If mosquitos are found in a proportion 2.32 times more often in outlying areas than in the center, then the following step-downs are implied: 1. Ring two, north and west: 1.88 2. Ring one, north and west: 1.44 3. Ring two, south and east: 1.44 4. Ring one, south and east: 1.22 See Figure VIII for a description of the rings. Sectors (north, south, east and west) generally follow rivers and the east shore of White Bear Lake.
E.	Leisure hours provided is equal to: - the number of mosquitos controlled multiplied by - the percent of time not denied as a result of this control (2.26% per controlled mosquitos) time multiplied by - the amount of time in hours desired (1.67 in the interior, 1.96 all other locations) multiplied by - the number of adults in each sector.

F. Insecticide cost reduction is equal to $.34 per household per year per drop in five minute mosquito counts. It is calculated by multiplying .34 by the number controlled (column E) by the number of households (column A).

TABLE E1-7

Impacts of Alternate Programs

	Interior	Ring 1 Suburbs	Ring 2 Suburbs	Total	Per Capita
Biological Control					
% Control	5	5	5		
Leisure					
1000 Hrs.	747	733	587	2067	1.06
$	36	31	24	91	
Physical Control					
% Control	60	60	60		
Leisure					
1000 Hrs.	8964	8796	7044	24804	12.67
$	432	372	288	1092	
Controlled Release					
% Control	95	95	95		
Leisure					
1000 Hrs.	14193	13927	11153	39273	20.06
$	684	589	456	1729	
Optimum Control					
% Control	95	95	95		
Leisure					
1000 Hrs.	14193	13927	11153	39273	20.06
$	684	589	456	1729	

Of the following which program would, in your opinion, ensure mosquito control?

	Response of those receiving control service	
	Number	Percent
1. A joint program with the District	6	19
2. A totally independent program controlled by you	2	6
3. An independent program controlled by the District	15	47
4. Uncertain	9	28

As regards to the operation of the current program, 9% indicated that spraying activities of a District interferred with or were a problem for people in the utilization of the area. These involved ball game spectators, tennis, and golf. Eighty-eight percent had never noticed this problem. This 9% figure seems quite low, considering the fact that adult control can only be done during the early evening or early morning hours, where such activities are quite common.

Most of the respondents also thought the District was capable of providing the kind of control they would like to see: 72% said this, 3% said no, and 25% were unsure.

Nevertheless, it was apparent from the survey that some uneasiness or uncertainty exists regarding coordination. Approximately half of the respondents felt the lines of communication were not sufficient or were unsure if they were sufficient. About 60% thought there was a need for more joint planning with the District, or were unsure about the need:

- Do you feel the lines of communication with the District are sufficient to provide for prompt solution of mosquito problems?

	No.	%		No.	%		No.	%
Yes	16	50	No	4	13	Uncertain	12	37

- Do you feel a need for more joint planning with the District personnel?

	No.	%		No.	%		No.	%
Yes	10	31	No	12	38	Uncertain	10	31

Lack of notification by District personnel prior to each spraying activity, and general timing of spraying activities have annoyed respondents in the past.

Ten locations (eight serviced by the District, two not serviced) are sprayed by their managers. Of those ten, six were currently conducting a program. The four cancelled programs were all currently serviced by the District. Representatives from two of these four programs thought a joint program with the MMCD to be the most effective: Two thought the District should handle the entire program independently. Five of these 10 areas which have had their own programs are in Anoka County, three are in Hennepin County, one is in Ramsey County, and one in Scott County.

	Item				
	Have had own Program		Want more joint Planning		Total from each County
County	No.	%	No.	%	No.
Anoka	5	72	4	57	7
Dakota	0	0	2	50	4
Hennepin	3	30	2	20	10
Ramsey	3	43	3	43	7
Scott	1	50	0	0	2
Washington	0	0	1	25	4

It was expected that programs in the northern (Anoka and Ramsey Counties) and western (Hennepin County) part of the District would probably have encountered serious enough problems to have experience with independent programs. That is borne out by the survey. Perhaps the most interesting result is that Hennepin County had only 20% positive response for a desire for more planning.

Over and above the question of administration ease and satisfaction are the questions of effectiveness in terms of ensuring recreational opportunities to Metropolitan residents. Limited funding and the paucity of mosquitos this season precluded the type of empirical data generation that is required for exact determination of the effect the program is having on recreational enjoyment.

Outdoor recreation administrators were asked to estimate park usage, however, and the percentage of persons using repellents, as a general indication.

Perhaps the most outstanding result is the simple fact that extensive evening outdoor recreation does not occur in areas without mosquito protection. This is shown by comparing: (A) The ratio of average evening attendance in unsprayed vs. sprayed areas (.55) with (B) the ratio of average daytime attendance in unsprayed vs. sprayed areas (.08).

If we could assume this is a representative sample, this would mean that seven times more evening activity occurs in outdoor areas if they are sprayed. What is undoubtedly closer to reality is that areas that have heavy demand for evening activities have already arranged for District assitance. The figures demonstrate that quite effectively.

Attendance figures for areas which reported many mosquito problems in the past indicate that an average of 850 people per week use these areas in the evening. Eliminating those 13% who use repellents, 747 can be assumed to be free from significant annoyance during each week. Using this as a basis for calculation, throughout the Metropolitan area, 417,882 persons use facilities per week in areas normally considered mosquito problem areas.

Using the figures shown above for park attendance and mosquito annoyance (from this small sample) one can apply them to the Metropolitan region as shown in Table EI-6.

Utilizing the same formula as for household residences, but presuming a pre-treatment population of B_5 = 7.1 and a resultant B_5 of .5 due to inflights of mosquitos after treatment, the hours not denied park users equal 1,880,200 per season. Savings in expenditures for repellents and sprays is $72,200 per 92 day season.

Due to the sketchy data base and uncertainty of supervisors about park attendance, results are speculative. In all probability, however, they are conservative.

In any case, for both larval control and adulticiding in recreation areas, total benefit hours (7,048,400) represent only those hours which are not denied. They do not represent benefits for those hours actually spent outdoors even though mosquitos are present.

In other words, denial is an underestimation of actual annoyance. Those who continue to recreate outdoors when mosquitos are active must be presumed to enjoy this time less than those who are not annoyed in this way. Expenditures on bug sprays and repellents ($415,800) are the only measure here for program benefits to those who are coping with a reduced mosquito annoyance.

ANALYSIS FIVE: MOSQUITO CONTROL: COST EFFECTIVENESS

Of special interest in regards to the future options of the MMCD is the willingness of the Metropolitan and individual community residents to maintain or increase their tax support of the MMCD. This was studied in three ways as part of a residential household survey:

1. Direct dollar savings on insecticides;

2. General opinions regarding funding for more effective control;

3. The dollar worth of control in terms of specific activities.

A comparison analysis to leisure impacts is the monetary impact of control via reduced private expenditures. Survey research completed in 1976 showed that, for moderate mosquito levels, households spend $.34 less for each drop in five minute mosquito counts. The formula is given by: $2.2 + $.34 (mosquito count), (see Figure X of the main text).

A summary of these savings that resulted are listed in Column 1, Table EI-6.

ANALYSIS SIX: WILLINGNESS TO PAY

The number of citizens who would be willing to spend was not directly measured, due to the limitations of the phone interview technique. A general measurement was made, however, on the basis of worth of interrupted activities. This was done via Question 36:

- On an annual basis, how much would it be worth to you in dollars to be free of mosquitos during this (your favorite) activity?

This is a valuable tool but something of a problem because of limited number of respondents. The median figures for those who responded was $10, see Table E1-7. This referred to only one activity. More extensive research would be required to precisely document overall values. It should be noted that only 45% of the respondents reported being restricted in a favorite outdoor activity and 35% responded a value for eliminating annoyance for an activity. Assuming the $10 for the respondents and assuming the other 55% had a $3.14 value (repellent and spray costs) for eliminating annoyance, this means that the "average" median value is about $6.23 per household.

Again, this is for a program that virtually eliminates annoyance from favorite activities.

Detailed new research along the lines of Question 36 would likely result in more certain and higher value estimates, especially if taken in a higher mosquito year. Perhaps it is fortunate that this was a year relatively free of mosquitos, since it prevents the kind of immediate influence that would be caused by high mosquito populations.

To sum up, many important variables are likely to have an influence in precise value of the program. These include:

- Actual mosquito populations
- The desire of persons for outdoor recreation;
- Income levels of different populations;
- Values of more than one activity.

To the extent that budget options are based on the limited data provided above, per capita costs should be held to $1.95.

TABLE EI-8

WORTH OF MOSQUITO CONTROL

QUESTION 36: ON AN ANNUAL BASIS, HOW MUCH WOULD IT BE WORTH TO YOU IN DOLLARS TO BE FREE OF MOSQUITOS DURING THIS (FAVORITE) ACTIVITY

	Number Interviewed	Asked No Answer	Median for Community Sample
Anoka County			
Anoka	29	13	4.8
Columbia Heights	40	0	19.7
Dakota County			
Farmington	42	3	3.2
So. St. Paul	25	37	9.8
Hennepin County			
Crystal	42	10	4.7
Mpls. Central	48	0	5.5
Mpls. South	30	22	15.5
St. Louis Park	73	7	14.9
Excelsior	24	35	12.0
Ramsey County			
Gem Lake	68	6	14.8
Mounds View	59	4	5.4
Roseville	25	9	10.2
St. Paul (East Side)	51	1	10.4
St. Paul (Highland)	31	22	15.0
Scott County			
Shakopee	45	7	2.2
Washington County			
Bayport	44	9	20.5
Overall No.	676	185	10.0
%	35.2	9.6	

ANALYSIS SEVEN: PUBLIC OPINION

An extensive analysis was done of the community's opinion's about increased funding. Relationships between these reactions will be contrasted with respondents' observations about the current program's adequacy and their 1976 experience with mosquitos.

Table EI-8 lists by community the % response to Question 28:

- If a higher level of mosquito control could be guaranteed, more public funds should be directed toward mosquito control.

As can be readily seen, there is not a great deal of variance between communities. Generally, residents were quite supportive of a better program. Some interesting results concerning the meaning of this support can be found in an examination of question of support for increased funding in terms of this year's mosquito populations.

Thus, citizens seem generally willing to spend more for real long-term effectiveness. While this survey would show some different results if taken in a high mosquito year, it is not expected that more than 80% of citizens would even respond they are willing to spend more on a more effective program even in a year of high mosquito density. This is a corallary to the conclusions reached above the diminished role of this year's experience on responses.

A final point is that there is a difference between an "adequate" program and an "ideal" program. The program appears to be "adequate" in most neighborhoods, especially this year, but people want to spend more to improve it further.

Analysis included a comparison between responses to questions 27 and 28. Question 27 reads:

- More should be done to control mosquitos in this neighborhood.

Possible responses to these questions are shown in Tables EI-8 and EI-9. The results are quite striking. While overall only 37% thought more should be done to control mosquitoes in the respondent's neighborhood, (Q. 27), 64% thought

TABLE EI-9

WILLINGNESS TO INCREASE MMCD FUNDING BY COMMUNITY

QUESTION 28: "IF A HIGHER LEVEL OF MOSQUITO CONTROL COULD BE GUARANTEED, MORE PUBLIC FUNDS SHOULD BE DIRECTED TOWARD MOSQUITO CONTROL."

County/Community	No. of Respondents	Disagree and Strongly Disagree %	Indifferent %	Agree and Strongly Agree %
Anoka County	233			63
Anoka	113	29	18	53
Columbia Heights	120	21	8	71
Dakota County	228			60
Farmington	109	30	15	55
South St. Paul	119	21	13	64
Hennepin County	604			66
Crystal	121	19	11	71
Mpls. Central	121	13	20	67
Mpls. South	123	27	20	54
St. Louis Park	119	21	8	72
Excelsior	120	21	14	64
Ramsey County	618			67
Gem Lake	122	19	9	72
Mounds View	131	12	14	74
Roseville	118	25	8	66
St.Paul (East side)	127	24	13	63
St.Paul (Highland)	120	30	9	60
Scott County	120			62
Shakopee	120	16	22	62
Washington County	120			59
Bayport	120	21	20	59
Overall	1923	22	14	65
No answer	10			

more funds should be directed to public control measures if more effectiveness was guaranteed (Q. 28). The direction was the same however. An important measurement of the co-predictability of response, (the Pearson correlation), was .3782.

The time frame had an important influence. The Pearson correlation between responses to Question 25:

- Mosquitos have been a bother during the last month.

and to (Q. 27) was reasonably high: .4096. However, the Pearson correlation was only .1885 between (Q. 25) and (Q. 28). This indicates that the support for more effective control was not tied to this year's experience, but reflects a long standing trend in citizen reaction. The same trend is noticed when comparing Question 26:

- Public control of mosquitos is adequate in this neighborhood and (Q. 28) to (Q. 25).

This time the correlations are negative, and again it is strong between (Q. 26) and (Q. 25) (-.3762) and weaker between (Q. 28) and (Q. 25) (-.1655).

To sum up for both (Q. 26) and (Q. 27), an adequacy of current control appears to have been interpreted by respondents as applying to the 1976 season, a record low mosquito year. Question 28, on funding for a more effective program, seemed a link between experience in the recent past and future possibilities.

READING THE RESULTS OF EFFECTIVENESS ANALYSIS

The elaborate set of formulas above which are necessary to derive an index of effectiveness is one indication of the complexity of the research problem. They are not its full measure.

Another element is the experience of the individual respondent and his expectations of annoyance. In part, this results from the degree of enjoyment outdoors. In part this is derived from the relative amount of annoyance he normally expects.

The experience recording in interviews in 1976 was excellent since it provided a baseline of reaction; "baseline,"

TABLE EI-10

ADEQUACY OF CONTROL IN RESPONDENTS; NEIGHBORHOOD

Q 27: MORE SHOULD BE DONE TO CONTROL MOSQUITOS IN THIS NEIGHBORHOOD

County/Community	No. of Respondents	Disagree and Strongly Disagree %	Indifferent %	Agree and Strongly Agree %
ANOKA	233	51	18	31
Anoka	113	48	18	34
Columbia Heights	120	53	18	29
DAKOTA	228	46	17	36
Farmington	109	48	15	37
So. St. Paul	119	45	19	36
HENNEPIN	604	47	13	40
Crystal	121	26	20	54
Mpls. Central	121	47	17	36
Mpls. South	123	73	7	20
St. Louis Park	119	44	6	51
Excelsior	120	46	14	40
RAMSEY	618	54	13	33
Gem Lake	122	52	8	40
Mounds View	131	45	16	39
Roseville	118	45	11	44
St. Paul (East side)	127	79	9	12
St. Paul (Highland)	120	47	22	32
SCOTT				
Shakopee	120	19	27	54
WASHINGTON				
Bayport	120	44	16	40
OVERALL	1923	48	15	37

because that year was one of record low annoyance. The natural result was for all persons to ignore the actual annoyance they received, and reduce the normal reaction to annoyance, especially in those outside the larval control boundary or near it that are the important control areas. A proper judgement of annoyance reduction awaits a longitudinal study of the populations reactions in a year of higher mosquito annoyance.

Thus, the figures provided by the survey of 1976 are minimal rather than representative. Identification of thresholds of mosquito annoyance, which had been the principle purpose of the research, was not possible.

Another point that needsto be made is that the highest mosquito populations are concentrated, generally, from June 15 to August 1, the longest and warmest evenings of the year. It is in these months that evening time is most valued and when protective clothing is most likely to cause discomfort. Take the case of the central areas on an average evening of the worst month of an average year. Persons outside would encounter about three mosquitos a minute. It is likely that thresholds of annoyance would be reached before this; i.e. much more than 38% time would be denied.

Furthermore, only evening counts were considered. When these get large enough, however, annoyance from mosquitos harboring in grassy areas may be sufficient to discourage even daytime activities. This occurs commonly in day camps to the north and west of the District.

Finally, it would greatly improve the accuracy and dependability of results to repeat many of the calibration techniques several times to gain a more thorough basis for judgements. Given time, manpower, and financial restrictions, however, this was not possible.

In the last analysis, the ultimate determination of whether mosquito control is effective enough to warrant the cost, are the people of the six-county District and their elected officials, the County Commissioners who govern the District.

They survey of last summer (1976) showed that satisfaction with performance was high as was a desire for more effective control. The Counties have generally been solidly united in their support as well.

There are improvements coming in the District's performance, and there always remains work to be done in planning and management to respond to technology changes and the demand for ever greater efficiency.

The bottom line is that the analysis or leisure time saved, while valuable as a model and as a baseline, cannot be assumed to have been fully calibrated by the survey. It remains a conservative estimate.

exhibit c.

EFFECTS OF TWO INSECTICIDES ON CRUSTACEAN POPULATIONS IN MMCD TYPE I MOSQUITO BREEDING SITES.

Empirical field studies were conducted by the MMCD in July, 1977 to measure the impacts of chlorpyrifos and temephos on crustacean populations in MMCD Type I mosquito breeding sites.

Test sites were selected in Anoka, Hennepin, Scott and Washington Counties averaging less than three acres in size. One hundred twenty four (124) sites were monitored in all. Crustacean populations were recorded at a minimum of one week after treatment with insecticides to control mosquito larvae. Samples from 36% of the sites were tested at the MMCD laboratory to verify field findings.

Forty-eight sites (48) were treated with chlorpyrifos 1% granules at rates of 5 lb/A and 10 lb/A (0.05 AI and 0.10 AI/A): 28 were treated with temephos at rates of 2.5 lb/A (0.025 lb AI/A); 48 were untreated control sites.

Field tests and laboratory verification were conducted to determine answers to two questions:

1) do crustacean populations vary proportionately between sites treated with chlorpyrifos and untreated control sites;

2) do crustacean populations vary proportionately between sites treated with temephos and untreated control sites.

Field and laboratory tests confirm that chlorpyrifos suppressed crustacean populations in test sites. Crustacean populations in sites after treatment with chlorpyrifos and in untreated control sites are shown in the following 2 x 2 contingency table.

CRUSTACEA	CHLOPYRIFOS TREATED	UNTREATED	TOTAL
PRESENT	28	42	70
ABSENT	20	6	26
TOTAL	48	48	96

The X^2 value is 10.338. The probability of this value occuring by chance is $p < .01$ assuming that treatments did not influence the occurence of Crustacea. (Note: Since the two 2 x 2 contingency tables analyzed here are correlated the X^2 values should be compared to $\chi^2_{1,\alpha/2}$. For an $\alpha = .05$ level of significance $\chi^2_{1,.05/2} = 5.02$.)

Similar testing resulted in the hypothesis that temephos has no significant effect on the occurence of Crustacea in MMCD Type I sites. Variations in the occurence of Crustacean populations in treated and control sites is as follows:

CRUSTACEA	TEMEPHOS TREATED	UNTREATED	TOTAL
PRESENT	20	42	62
ABSENT	8	6	14
TOTAL	28	48	76

In the foregoing table, the X^2 value is 3.039. The probability that this value would occur by chance is $p < .15$ assuming treatments did not influence the occurence of Crustacea.

Crustacea were found to occur as follows:

CRUSTACEA	CHLORPYRIFOS TREATED	TEMEPHOS TREATED	UNTREATED
PRESENT	28	20	42
ABSENT	20	8	6
TOTAL	48	28	48

Crustacea observed in laboratory samples included daphnia, copepods, ostracods and amphipods.

The probability of the occurence of Crustacean populations in MMCD Type I sites (with associated 95% confidence interwals) under treatment conditions is as follows:

TREATMENT	LOWER BOUND	PROBABILITY	UPPER BOUND
CHLORPYRIFOS	.42	.58	.72
TEMEPHOS	.51	.71	.86
UNTREATED	.76	.88	.95

One can expect, as a result of this analysis, that chlorpyrifos will have some effect on Crustacea, and that temephos will have no significant effect on these populations.

The effects of physical mosquito control program alternatives on plant and animal communities in the Twin Cities have been determined by Huff (1976).

Predictions are presented in Tables EI-11 through EI-13. Values assigned to physical impacts in tables EI-11 and EI-12 are based upon the following key:

Symbols used in the table are:

++ = Significant increase

+ = Moderate increase

0 = Little or no effect

- = Moderate decrease

-- = Significatnt decrease

NA = Not applicable

TABLE EI-11

PROBABLE EFFECTS OF MMCD PHYSICAL CONTROL ALTERNATIVE ON PLANT COMMUNITIES COMMON TO THE TWIN CITIES METROPOLITAN AREA

Community	Physical Control Alternative[1] 1. Runoff Diversion	2. Pond Consolid.	3. Is./Moat Construction	4. Sorel. Sl. Mod	5.Det. Removal	6. Dep. Filling
Upland Prairie (high water tab.)	+	+	0	+	0	+
Upland Prairie (low water tab.)	NA	NA	NA	NA	0	+
Aquatic Commun.	--	-	-	-	--	--
Sedge Meadow, Alter/Willow Swamps[2]	--	-	--	-	--	NA
Tamarack/White Cedar Swamps	NA	NA	-	NA	NA	NA
Swamp Hardwood Forest	NA	NA	-	NA	NA	NA
Floodplain Forest	NA	NA	0	0	0	NA
Oak Savanna	0	0	NA	NA	NA	0
Northern Pine/Red Oak Forest	NA	+	0	0	0	+
White Oak Forest	NA	+	0	0	0	+
Maple/Basswood Forest	-	-	+	-	NA	+
Seral Forest Commun. (Aspen-Birch)[2]	+	+	0	0	0	+
Bluff/Cliff Commun.	NA	NA	NA	NA	NA	NA

[1]Abbreviations are for 2. Pond Consolidation, 3. Island/Moat Construction, 4. Shoreline Slope Modification, 5. Detritus Removal, and 6. Depression Filling

[2]Not mentioned Hughes (1973)

Source: Huff, 1976b.

TABLE EI-12

PROBABLE EFFECTS OF MMCD PHYSICAL CONTROL ALTERNATIVES ON POPULATIONS OF WILDLIFE SPECIES COMMON TO THE TWIN CITIES METROPOLITAN AREA.

Species or Group	Physical Control Alternative[1] 1. Runoff Diversion	2. Pond Consolid.	3. Is./Moat Construction	4. Shorel. Sl. Mod.	5. Det. Removal	6. Dep. Filling
1. Tree-nesting songbirds	+	+	0	0	-	0
2. Ground-nesting songbirds	+	+	0	0	-	-
3. Pheasant	-	-	+	0	0	0
4. Waterfowl (nesting)	--	-	+	-	-	-
5. Waterfowl (casual migrants)	--	-	0	-	-	-
6. Raptors	0[2]	0[2]	0	0	0	0
7. Crows	0	0	0	0	0	0
8. Mice and Voles	+	+	0	0	0	0
9. Shrews	-	0	0	-	-	-
10. Pocket goghers and moles	+	+	0	0	0	+
11. Rabbits & Hares	+	+	0	0	0	+
12. Fox, gray, & red squirrels	+	+	0	0	0	+
13. Ground squirrels	+	+	0	0	0	+
14. Muskrat/Beaver	-	-	+	+	0	0
15. Mink	-	-	+	0	0	-
16. Fox	+	+	-	0	0	+
17. Weasels	+	+	-	0	0	+
18. Skunks	+	+	0	0	0	-
19. Raccoon	-	-	-	0	0	-
20. White-tailed deer	+	+	0	0	0	-
21. Reptiles	-[3]	-[3]	+	0	-	-
22. Amphibians	--	--	-	-	-	--
23. Zooplankton, aquatic insects, fish	--	--	+	+	-	-

[1]Abbreviations are for: 2. Pond Consolidation, 3. Island/Moat Construction, 4. Shoreline Slope Modification, 5. Detritus Removal, and 6. Depression Filling.

[2]Species composition of resident raptors will probably change.

[3]Species changes will probably reduce overall effects.

Source: Huff, 1976b.

TABLE EI-13

UNIQUE AND RARE SPECIES OF BIRDS, REPTILES, AND AMPHIBIANS POSSIBLY AFFECTED BY MMCD PHYSICAL CONTROL ALTERNATIVES

SPECIES	HABITAT DESCRIP.	MGMT. RECOMMEND.
1. Great blue heron (Ardea herodias)	Lakes, marshes, rivers	Avoidance of nesting colonies
2. Great egret (Caserodius albus)	Same as above	Same as above
3. Cooper's hawk (Accipiter cooperii)	Oak & Tamarack thicket edges	Maintenance of undisturbed Tamarack swamps & oak woods
4. Marsh hawk (Circus cyaneus)	Open marshes, wet depressions in fields & grasslands	Maintenance of wetlands & contiguous uplands
5. Yellow rail (Coturnicops noveboracensis)	Cattail marshes	Maintenance of cattail marshes
6. LeConte's sparrow (Passerherbulus caudacutus)	Bogs and marshes	Maintenance of bogs, marshes, and some adjacent upland
7. Henslow's sparrow (Passerherbulus henslowii)	Same as above	Same as above
8. Jefferson's salamander (Ambystoma jeffersonianum)	Low-lying woodlands	Maintenance of moist woodlands with ephemeral ponds
9. Common newt (Notophtalmus viridescens)	Same as above	Same as above
10. Wood turtle (Clemmys insculpta)	Slow streams & woodland ponds	Maintenance of slow streams and woodland ponds
11. Blanding's turtle (Emys blandingii)	Small streams, ditches, and marshes	Maintenance of stream ditches, and marshes

Source: Huff, 1976B.

bibliography

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