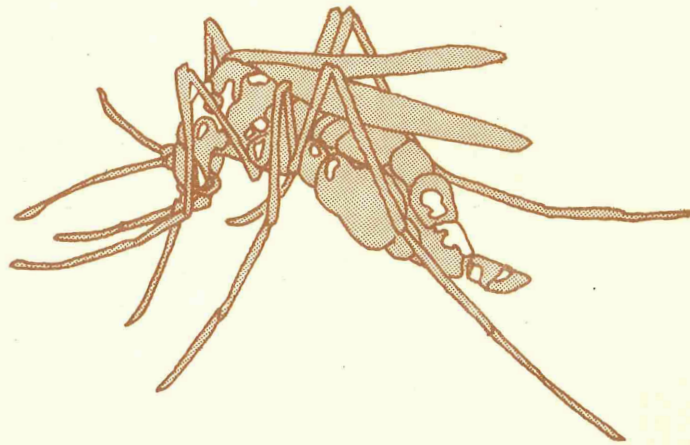




MMCD E.I.S.

OPTIONS FOR CONTROL TO THE YEAR 2000



RA
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appendix

APPENDIX

MMCD EIS
OPTIONS FOR CONTROL
TO THE YEAR 2000

ADDENDUM TO THE
DRAFT APPENDIX

November, 1977

LEGISLATIVE REFERENCE LIBRARY,
STATE OF MINNESOTA

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<u>Page</u>	<u>Paragraph</u>	<u>Line</u>	<u>Item</u>
es-1	heading	1	Ecology should be Environmental Description.
es-2	Table ES-1	last	Add SOURCE: Huff, 1976a
es-7	5	4	Higeon should be Higem
es-7	6	3	P ¹ should be P'
es-9	Table ES-2	Column 2	P ¹ should be P'
es-9	Table ES-2	last	Add SOURCE: Pfannkuch, 1976.
es-10	3	last	1976 should be 1967
es-13	Table ES-3	last	Add SOURCE: Pfannkuch, 1976
es-14	Table ES-4	last	Add SOURCE: Pfannkuch, 1976
es-27	Table ES-6	last	SOURCE: Mn. State Planning Agency, 1976.
es-29	5	1	affect should be effect
es-29	5	last	(Goma, 1966).
es-31	Table ES-7	last	Add SOURCE: Keller, 1976.
es-33	1	last	Change & to and
es-33	3	last	(Schlotthauer, 1976; Shupe <u>et al.</u> , 1973).
es-35	2	last	(Harrison <u>et al.</u> , 1965).
es-37	3	2	...research: The...
es-47	7	f	Picnicking
es-47	8	f	Picnicking

<u>Page</u>	<u>Paragraph</u>	<u>Line</u>	<u>Item</u>
es-48	9	f	Picnicking
es-50	25	f	Picnicking
es-51	29	f	Picnicking
es-52	30	f	Picnicking
es-57	12	2	guaranteed not guarenteed
es-58	14	3	affect should be effect
es-80	1	12	separated not spearated
es-80	3	6	of should be or
es-85	1	3	be not by
es-85	1	6	environment
es-86	1	12	... continued in effect.
pd-16	3	1	eight should be seven
pd-16	4	1	<u>Mansonia</u> should be <u>Coquillettidia</u>
pd-17	4	3	<u>Mansonia</u> should be <u>Coquillettidia</u>
pd-17	4	12	... surface (Barr, 1958).
pd-18	3	14	univalent not monovalent ...sodium, potassium...
pd-21	3	3	<u>Mansonia</u> should be <u>Coquillettidia</u>
pd-21	31	17	<u>Mansonia</u> should be <u>Coquillettidia</u>
pd-22	1	8	flat worm should be flatworm.

<u>Page</u>	<u>Paragraph</u>	<u>Line</u>	<u>Item</u>
pd-22	3	7,8	(Sjogren and Thies, 1976; Schandle et al., 1976; Schandle, 1976).
pd-23	3	2	omit, after Thies
pd-24	1	10-18	should read: (Van Doren and Klingfiel, 1952; Aldrich and Schonover, 1951; Houston et al., 1955). Exceptions exist (Schaefer 1977).
pd-32	Section title #2		Material Code 2-4-16-20... not code 2-16
pd-33	3	2	...rate of (2.5) or (5.0) lb ...
pd-33	3	3	(0.025 AI) or (0.05 AI)
pd-33	4	2	...rate of (5.0) or (7.5) lb...
pd-33	4	3	(0.05 AI) or (0.075 AI)
pd-34	3	3	(0.05 AI)
pd-34	4	3	(0.1 AI)
pd-35	1	3	(0.05 AI)
pd-35	2		omit paragraph
pd-35	last	last	(0.05 AI)
pd-36	8	7	(0.025 AI)
pd-37	1	3	(0.025 AI)
pd-37	2	6	(0.05 AI)
pd-37	Section title		...Code 3-8-19...
pd-37	last	last	...low volume sprayer. omit the rest of sentence.

<u>Page</u>	<u>Paragraph</u>	<u>Line</u>	<u>Item</u>
pd-38	1	1	omit first line
pd-38	3		omit paragraph
pd-38	2	3	(0.34 AI)
pd-38	4	3	(0.5 AI)
pd-38	5	3	(0.5 AI)
pd-40	7	7	(0.004 AI)
pd-41	4	2	Contaiminated should be Contaminated.
pd-41	8	4	change 4 or 5 cups to one half cup
pd-57	bottom of the table		the last line of boxes should say Four Seasonal Employees for each foreman
pd-65	last	last	...work of Ellman <u>et al.</u> , (1961).
pd-66	2	1	Dursban should be chlorpyrifos
pd-66	5	1	Dursban should be chlorpyrifos
ei-1	8	1	Lawrence should be Laurence
ei-2	2	1	Paul E. Lichtenstein
ei-2	6	1	Dr. Rizwanul Haque
ei-3	A	#2	terrestrial not terrestrail
ei-14	2	1	Lawrence should be Laurence
ei-15	2	1	...applications/year
ei-19	2	5,6	Omit This occurs...years - Start new sentence On normal...

THE FOLLOWING PAGES ARE REPLACEMENTS WHERE SUBSTANTIVE CHANGES HAVE BEEN MADE, OR ARE ADDITIONS TO THE DRAFT APPENDIX.

INCLUDED ARE PART OF APPENDICES ES AND PD. THE EFFECTIVENESS ANALYSIS FROM APPENDIX EI HAS BEEN REWRITTEN, AND THE BIBLIOGRAPHY EXPANDED.

e. s. —

exhibit a. 

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	2399	12.8	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 breed- ing sites	Total area (acres) B.S.	Number of breed- ing 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
Marshall	36.	23040	93.24	68	15	0.73	0.22	.07	68	15.0	.22	-	-	-	0.07				
Mendota Hgts.	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 breed- ing sites	Total area (Acres) B.S.	Number of breed- ing 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 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
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	2.03	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	7302	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.

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

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 hypsensitization (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-8, Continued

<u>County</u>	1975	
	Reported	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.

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 (diethylcarbazine) 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

exhibit d. 



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) 10.8%
INERT INGREDIENTS: 89.4%
EPA Registration No. 484-517
EPA Est. 484-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 Thoroughly 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, intermit-
tently 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 distri-
bution of the pellets.

Flooded Area Treatments Apply DURSBAN 10 CR Insec-
ticide 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. Re-
treat 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 recom-
mended on this label. Do not apply where these are im-
portant 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 chemi-
cal 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 war-
ranty 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. 3,244,585

22.68 KG/50 LB

A770

THE DOW CHEMICAL COMPANY

MIDLAND MICHIGAN 48602 USA ZÜRICH SWITZERLAND HONG KONG
CORAL GABLES FLORIDA 33134 USA BARRIE ONTARIO CANADA
A Division 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 LABELS.

REVISIONS INCLUDE: CORRECTION OF SPELLING ERROR IN CONTAINER
DISPOSAL INSTRUCTIONS.

p. d. —

exhibit c.

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 finished spray material.

Material Code 7 Pyrethrum liquid concentrate mixed with mineral oil to be used as a ground adulticide only. (0.004 AI)

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 aerosol 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:

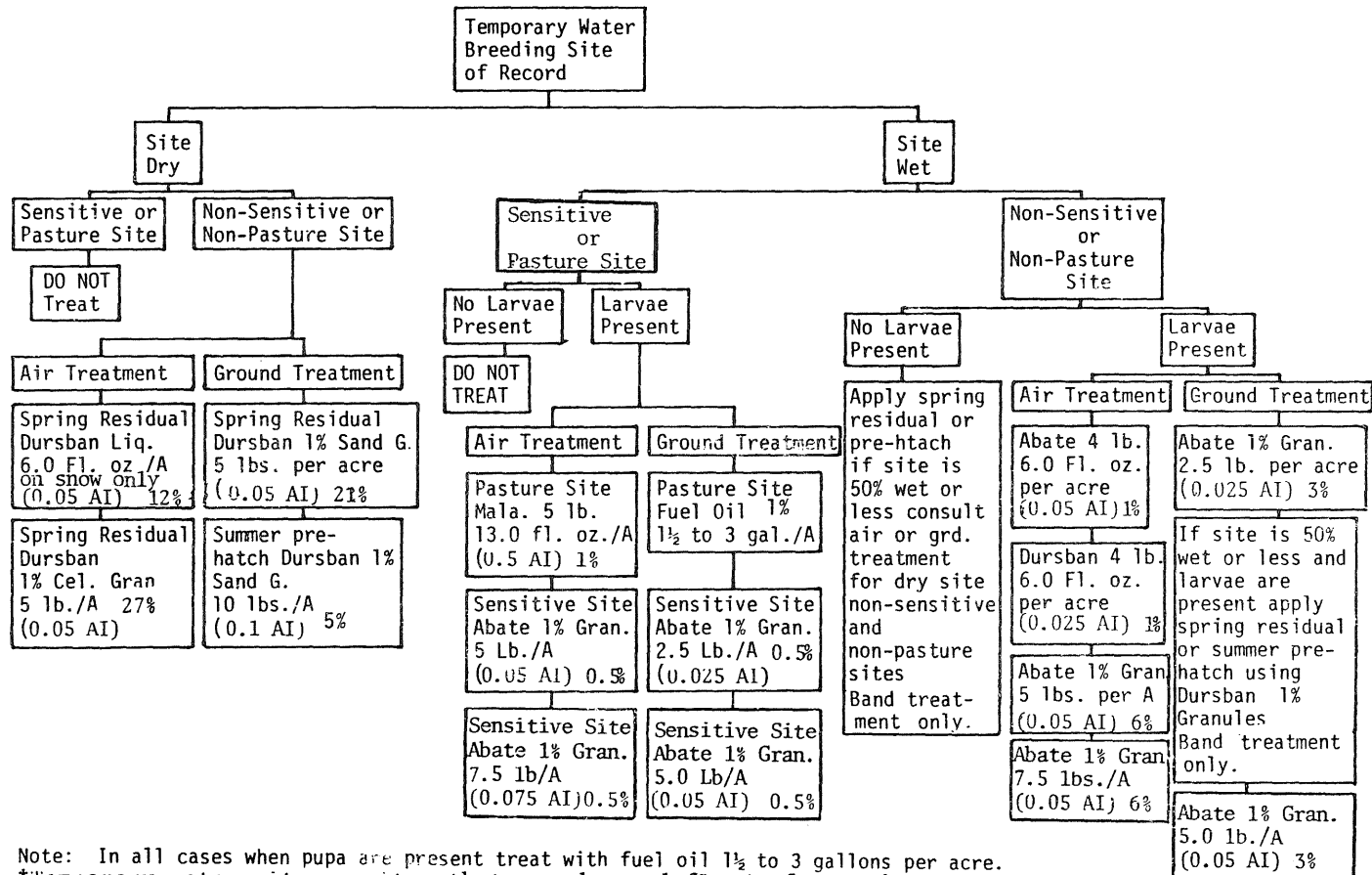
Limited to non-thermal aerosol generator and Hudson Back Pack treatments only.

SAFETY PRECAUTIONS:

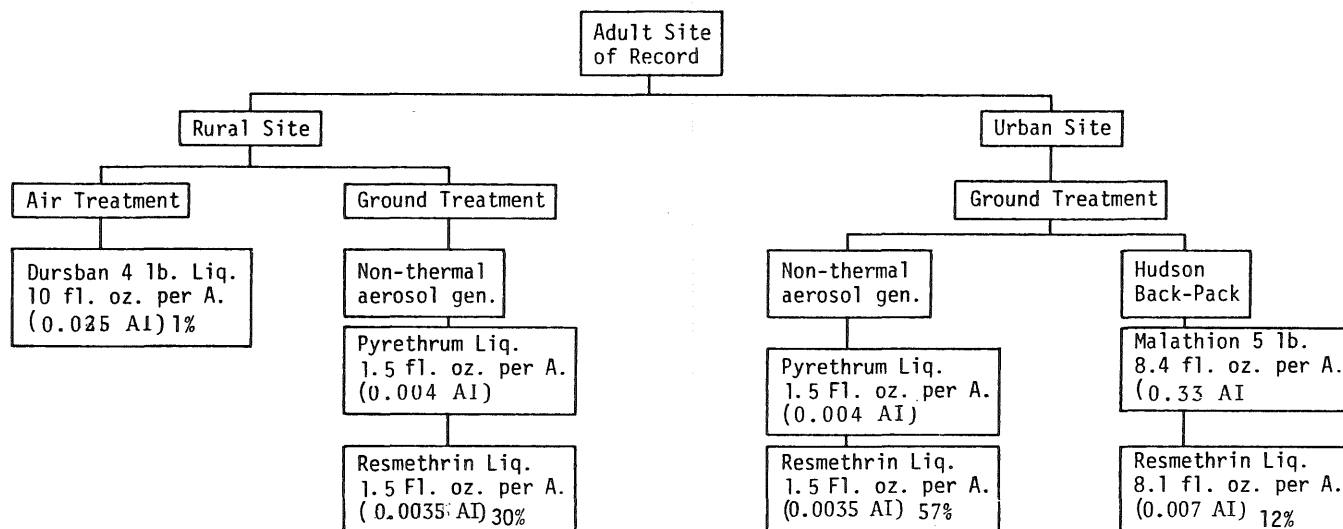
Gloves and boots shall be worn by employees while filling insecticide tanks on equipment. No protective gear is required while applying material from the vehicle. The insecticide supply valve will be shut off before leaving vehicle cab to inspect, stop, or start machine.

METROPOLITAN MOSQUITO CONTROL DISTRICT

GUIDELINES FOR LARVAL MOSQUITO CONTROL MEASURES FOR *TEMPORARY WATER SITES 61,000 Acres Treated Annually (90% of all Acres Treated)



METROPOLITAN MOSQUITO CONTROL DISTRICT
GUIDELINES FOR ADULT MOSQUITO CONTROL MEASURES
 233,932 Acres Treated Annually



(1% Aerial Treatment, 99% Ground Treatment)

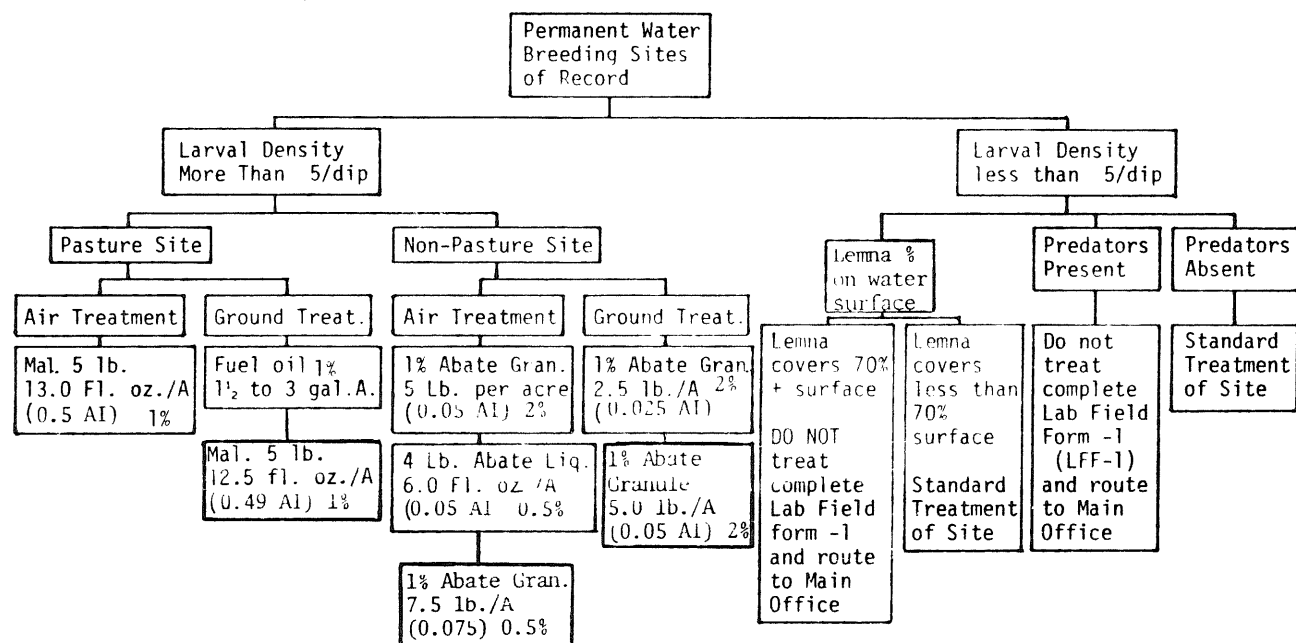
Air treatment with Dursban 4 lb. liquid at 0.025 AI requires prior approval of the Director.

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

GUIDELINES 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.

exhibit f. 

METROPOLITAN MOSQUITO CONTROL DISTRICT
DAILY INSPECTION AND TREATMENT REPORT

COUNTY 1

DATE 2

MATERIAL CODES & PEP ACRE DOSAGE RATES					
1 FUEL OIL	1-3 GALS.	8 MALATHION 5LB	8.4 FL. OZ.		
2 ABATE 1%	2.5 LBS.	9 RESMETHRIN 40%	8.1 FL. OZ. F.S.		
3 MALATHION 5LB.	12.5 FL. OZ.	10 RESMETHRIN 40%	1.5 FL. OZ. F.S.		
4 ABATE 1%	5 LBS.	12 DURS BAN 1% SAND	5 LBS.		
5 RESMETHRIN 18.5%	1.5 FL. OZ. F.S.	13 DURS BAN 1% SAND	10 LBS.		
6 RESMETHRIN 18.5%	8.1 FL. OZ. F.S.				

FOREMAN 3

INSPECTOR 4

INSPECTOR 5

N U M B E R	SITE IDENT.			INSPECTION RECORD				TYPE INSPECTION										TYPE TREATMENT						TREATMENT RECORD			REMARKS
	TWP	SEC.	B.S. OR A.S.	B W R T E N E D	B R E E D I N G	D R Y	L/P PER D.P. ADULTS 5 MIN.	% WET	G R O U N D L	G R O U N D A	A I R L	A I R A	P H	T R E E S	C O N D U C T I V I T Y	G R O U N D L	G R O U N D A	P H	F F 9	600 1700	M A T C O D E	GALS OZ LBS.	T R E A T E D	A C R E S			
1	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		
2																											
3																											
4																											
5																											
6																											
7																											
8																											
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25																											
26																											
27																											
28																											
29																											
30																											
FF-2 REVISED 1-77				TOTALS				32																			

MONTHLY INSPECTION, TREATMENT AND INSECTICIDE USE REPORT

COUNTY _____ MONTH _____

PAGE 1 OF 2

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	10.5% 5 RESMETHRIN 1.5 FL. OZ. PER ACRE	10.5% 6 RESMETHRIN 8.1 FL. OZ. PER ACRE	7 PER ACRE	8 MALATHION 8.4 FL. OZ. PER ACRE	40% 9 RESMETHRIN 8.1 FL. OZ. PER ACRE	40% 10 RESMETHRIN 1.5 FL. OZ. PER ACRE	11 11.5 OZ. PER GAL. F.S.	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				

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 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.															
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 3-76

[illegible]

MONTH _____

DISTRICT INSECTICIDE USE REPORT (GROUND)

MMCD 3-76

COUNTY	GROUP 1 GROUND LARVICIDE								GROUP 2 GROUND ADULTICIDE								GROUP 3 GROUND P.H. & RESIDUAL													
	1		2		3		4		18.5% 5		18.5% 6		7		8		40% 9		40% 10		11		12		13		14			
	FUEL OIL TO 3 GAL. PER ACRE		ABATE 1% 2.5 LBS. PER ACRE CELATOM GRANULE		MALATHION 12.5 FL. OZ. PER ACRE		ABATE 1% 5 LBS. PER ACRE CELATOM GRANULE		RESMETHRIN 1.5 FL. OZ. PER ACRE 25.6 OZ. PER GAL. F.S.		RESMETHRIN 8.1 FL. OZ. PER ACRE 9.3 OZ. PER GAL. F.S.				MALATHION 8.4 FL. OZ. PER ACRE		RESMETHRIN 8.1 FL. OZ. PER ACRE 4.3 OZ. PER GAL. F.S.		RESMETHRIN 1.5 FL. OZ. PER ACRE 11.5 OZ. PER GAL. F.S.				DURSBAN 1% 5 LBS. PER ACRE SAND GRANULE		DURSBAN 1% 10 LBS. PER ACRE SAND GRANULE		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																														

MONTH _____

DISTRICT INSECTICIDE USE REPORT (AIR)

MMCD 3-76

[illegible]

MONTH _____ DISTRICT MONTHLY INSECTICIDE USE AND ACRES TREATED COMPOSITE

MMCO 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.

e. i. —

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)

	<u>Average Night Counts</u>		<u>Ratios of worst month to other months</u>
<u>Trap No.</u>	<u>Worst Month</u>	<u>Other Months</u>	
Controlled Traps			
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 trap¹ populations were compared to landing counts in neighborhoods near the traps for six observations. The following results occurred:

¹District 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)	Rela- tionship 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

<u>Light Trap No.</u>	<u>All years' average</u>		<u>1960,1961,1964,1970,1971</u>	
	<u>Worst</u>	<u>Other</u>	<u>Average</u>	
<u>Controlled</u>	<u>Month</u>	<u>Months</u>	<u>Worst Month</u>	<u>Other Months</u>
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
	<u>706.5</u>	<u>1.000</u>	

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

<u>Light Trap No.</u> <u>Controlled</u>	<u>No. of Active</u> <u>Type I Acres</u>
1	621
3	<u>2,003</u>
Average	1,312
<u>Uncontrolled</u>	
4	2,761
5	3,195
9	1,523
16	<u>4,714</u>
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 ($510.8 \times .866 = 442$). By a similar analysis, the other two months would have 94 ($251/2.32 \times .866 = 94$).

On an average $(\frac{2 \times 94 + 442}{3})$, there would have been 210 mosquitos each evening. There were actually 30 (see Table EI-3) $(\frac{2 \times 15.6 + 58.5}{3} = 30)$. 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 occurred 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:

$$\Delta B_{15} = .099 (\Delta \text{Light trap}), \text{ with the 95\% confidence level} = \pm .018 (\text{Light trap}).$$
6. For differences between two 5 minute bite counts (ΔB_5), the equation reads: $\Delta B_5 = \frac{\Delta B_{15}}{3}$
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 $\pm .006$ (Δ Light 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:

denied time = ideal time - 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:

$$\begin{aligned} (.82) \text{ Bite Count} + 8.15 &= \text{percent denied time} \\ &\text{and} \\ (3.57) \text{ Bite Count} + 20.67 &= \text{percent denied time} \end{aligned}$$

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			D Mosquitos Occurring	E #Contr. per 5 min. bite count	Impacts	
	A # Households	B # Adults	C % Contr.			F Leisure hrs. Provided (1,000 hrs.)	G 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 <u>not denied</u> 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	
	<u>Number</u>	<u>Percent</u>
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 interfered 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?

	<u>No.</u>	<u>%</u>		<u>No.</u>	<u>%</u>		<u>No.</u>	<u>%</u>
Yes	16	50	No	4	13	Uncertain	12	37

- Do you feel a need for more joint planning with the District personnel?

	<u>No.</u>	<u>%</u>		<u>No.</u>	<u>%</u>		<u>No.</u>	<u>%</u>
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.

<u>County</u>	<u>Item</u>				<u>Total from each County</u>	
	<u>Have had own Program</u>		<u>Want more joint Planning</u>			
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>		
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 assistance. 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: $\$2.2 + \$.34 (\text{mosquito count})$, (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 Inter- viewed	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 corollary 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 needs to 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.

Their 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 of 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 χ^2 value is 10.338. The probability of this value occurring by chance is $p < .01$ assuming that treatments did not influence the occurrence of Crustacea. (Note: Since the two 2×2 contingency tables analyzed here are correlated the χ^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 occurrence of Crustacea in MMCD Type I sites. Variations in the occurrence 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 χ^2 value is 3.039. The probability that this value would occur by chance is $p < .15$ assuming treatments did not influence the occurrence 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 occurrence of Crustacean populations in MMCD Type I sites (with associated 95% confidence intervals) under treatment conditions is as follows:

TREATMENT	LOWER BOUND	PROBABILITY	UPPER BOUND
CHLORPYRIFOS	.42	.58	.72
TEMEPHOS	.51	.71	.92
UNTREATED	.76	.88	.99

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
- = Significant 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. Shorel. 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

¹Abbreviations are for 2. Pond Consolidation, 3. Island/Moat Construction, 4. Shoreline Slope Modification, 5. Detritus Removal, and 6. Depression Filling

²Not 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 gophers 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	--	--	+	+	-	-

¹Abbreviations are for: 2. Pond Consolidation, 3. Island/Moat Construction, 4. Shoreline Slope Modification, 5. Detritus Removal, and 6. Depression Filling.

²Species composition of resident raptors will probably change.

³Species 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 (<u>Ardea herodias</u>)	Lakes, marshes, rivers	Avoidance of nesting colonies
2. Great egret (<u>Casero dius albus</u>)	Same as above	Same as above
3. Cooper's hawk (<u>Accipiter cooperii</u>)	Oak & Tamarack thicket edges	Maintenance of undisturbed Tamarack swamps & oak woods
4. Marsh hawk (<u>Circus cyaneus</u>)	Open marshes, wet depressions in fields & grasslands	Maintenance of wetlands & contiguous uplands
5. Yellow rail (<u>Coturnicops noveboracensis</u>)	Cattail marshes	Maintenance of cattail marshes
6. LeConte's sparrow (<u>Passerherbulus caudatus</u>)	Bogs and marshes	Maintenance of bogs, marshes, and some adjacent upland
7. Henslow's sparrow (<u>Passerherbulus henslowii</u>)	Same as above	Same as above
8. Jefferson's salamander (<u>Ambystoma jeffersonianum</u>)	Low-lying woodlands	Maintenance of moist woodlands with ephemeral ponds
9. Common newt (<u>Notophtalmus viridescens</u>)	Same as above	Same as above
10. Wood turtle (<u>Clemmys insculpta</u>)	Slow streams & woodland ponds	Maintenance of slow streams and woodland ponds
11. Blanding's turtle (<u>Emys blandingii</u>)	Small streams, ditches, and marshes	Maintenance of stream ditches, and marshes

Source: Huff, 1976B.

bibliography

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