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Fish and Wildlife Resources of the Great Lakes Coastal Wetlands within the United States

OHSU-T-30-006 c.2

VOLUME FIVE: LAKE MICHIGAN, PART I

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in cooperation with

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TABLE OF CONTENTS

PREFACE	i
ACKNOWLEDGEMENTS	ii
LIST OF CONTRIBUTORS	iii.
INTRODUCTION	vi
LIST OF TABLES	xxxix
LIST OF FIGURES	xxxv
LAKE SECTION 1	1
LAKE SECTION 2	63
LAKE SECTION 3	163
LAKE SECTION 4	253
LAKE SECTION 5	391
LAKE SECTION 6	453
LAKE SECTION 7	495
LAKE SECTION 8	542
LAKE SECTION 9	588
LAKE SECTION 10	679
LAKE SECTION 11	901
LAKE SECTION 12	1041
LAKE SECTION 13	1105
LAKE SECTION 14	1269
LAKE SECTION 15	1366
SUMMARY	1464
LIST OF APPENDICES	1474
APPENDIX A - Fish	1477
APPENDIX B - Invertebrates	1479
APPENDIX C - Reptiles and Amphibians	1485
APPENDIX D - Avifauna	1503
APPENDIX E - Mammals	1549
APPENDIX F - Endangered Species	1555
BIBLIOGRAPHY	1562
LIST OF USGS MAPS	1590
LIST OF ROCKFORD MAP PUBLISHERS, INC. PLAT BOOKS.	1592

PREFACE

OBJECTIVES

The purpose of the volumes of which this is the fifth is the compilation of published information concerning fish and wildlife resources and environmental factors in the coastal wetlands of the Great Lakes within the United States. Specific objectives were as follows:

- (a) to delineate and describe all wetland areas along the Great Lakes shorelines
- (b) to inventory the fish and wildlife resources of these wetlands
- (c) to describe the physiographic and cultural setting in which these wetlands are situated, and
- (d) to determine the voids in knowledge pertaining to the fish and wildlife resources of the Great Lakes coastal wetlands.

The Great Lakes region has been divided into five areas of study, each consisting of a single lake and its connecting channel. These five areas are (1) Lake Ontario and the St. Lawrence River; (2) Lake Erie and the Niagara River; (3) Lake Huron and the St. Clair River, Lake St. Clair and the Detroit River; (4) Lake Michigan and the Mackinac Straits; and (5) Lake Superior and the St. Mary's River. Each such area comprises one volume in this study. An overview volume has been prepared which serves as an introduction to the five lake volumes.

The information summarizing the study areas is based on an extensive literature search undertaken by the Ohio State University Center for Lake Erie Area Research and the Indiana University Environmental Systems Application Center. Major sources of information included referee journals and various technical and popular publications of the state departments of natural resources, libraries, universities, federal, state, and local agencies, multi-agency commissions having Great Lakes responsibilities, and private groups and individuals possessing knowledge of Lake Michigan's coastal wetlands. In some cases unpublished open file data of various agencies and individuals was used. The sheer volume and the unfinished nature of unpublished data precluded its extensive use. Many agencies, institutions, and individuals were contacted by letter, telephone, or personal visit and provided valuable assistance in the acquisition and interpretation of published information. A complete listing of agencies, institutions, and individuals contacted appears in the Overview Volume (Volume #1).

ACKNOWLEDGEMENTS

This report represents the joint efforts of the Ohio State University Center for Lake Erie Area Research and the Indiana University Environmental Systems Application Center. The staff of the Center for Lake Erie Area Research was responsible for the preparation of Vegetation, Fish, Invertebrates, Mammals, and Endangered Species components of Biotic Setting. Indiana University, School of Public and Environmental Affairs was responsible for Physiographic Setting and Cultural Setting, as well as Avifauna, Reptiles and Amphibians.

Assistance from federal, state, and local agencies, educational institutions and private individuals was splendid.

We would like to acknowledge all of the individuals contacted during this study who provided us with information concerning the coastal wetlands of Lake Michigan.

Special thanks are extended to Charles C. King for his participation as coordinator of the Peer Review Group. We would like to thank all the members of the Peer Review Group for their valuable guidance. The seven members of the Peer Review Group are: Dr. William E. Cooper, Michigan State University; Dr. Henry L. Hunker, The Ohio State University; Dr. Orrie Loucks, University of Wisconsin; Dr. Frederick Marland, Georgia Department of Natural Resources; Dr. William Niering, Connecticut College; Dr. Henry A. Regier, University of Toronto; Dr. Milton B. Trautman; The Ohio State University; and Dr. Charles C. King, Ohio Biological Survey.

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INTRODUCTION

WETLAND IDENTIFICATION AND DELINEATION

This volume concerns the coastal wetlands of Lake Michigan and the Mackinac Straits. U.S. Geological Survey quadrangle maps (scale 1:24,000 or 1:62,500, depending on availability) were the primary basis for identifying and delineating all coastal wetlands. An arbitrary boundary line was drawn on these maps 1,000 feet landward of the normal high water mark at all points along the Lake Michigan shore. All wetlands depicted on the maps which were contained entirely or partially between the 1,000 feet boundary and the shore, whether contiguous to the lake or not, were included in the review. Wetlands located wholly or partially within 1,000 feet of a coastal body of water such as a bay, harbor, or estuary, or small lakes and ponds with direct connections to Lake Michigan, were similarly included. Figure 1 illustrates the above delineation rules.

An aerial reconnaissance of the Lake Michigan shoreline was conducted during July, 1978 to verify the existence of the wetlands shown on the quadrangle maps as well as to provide some first-hand familiarity with the wetlands and their setting. Based on the quadrangle maps and aerial reconnaissance, 417 wetlands were identified and delineated along the Michigan shoreline. The 417 wetlands of Lake Michigan are located along approximately 1,632 shoreline miles in Michigan, Indiana, Illinois and Wisconsin.

USE OF THIS DOCUMENT

In order to facilitate the use of this report, the Michigan shoreline has been divided into 15 lake sections (Table 1 and Figure 2). Each lake section corresponds to a separate chapter within this report. By looking at Figure 2, users of this document can determine which lake section contains the wetland(s) in which they are interested. Once this has been accomplished, the "Introduction" section of the appropriate lake section chapter should be consulted. A more detailed map of the shoreline is contained within the chapter Introduction. This map will permit users of the document to find the specific wetland(s) for which they are seeking information. The grouping of wetlands in a lake section does not necessarily imply physical or biological relationships among those wetlands. Rather, these sections are simply organizational devices and usually were drawn according to political boundaries or the density and distribution of wetlands along the coast.

Each wetland has been described in terms of its physiographic, biotic, and cultural characteristics. Table 2 identifies the sub-components considered within these three components. Where available, wetland-specific data are presented first within the individual wetland narratives, followed by historical or general information of relevance to the wetland. Reference may also be made to one of the appendices contained at the end of the report when more generalized but non-specific information is applicable to the wetland. A list of threatened and endangered species of Michigan, Indiana, Illinois, and

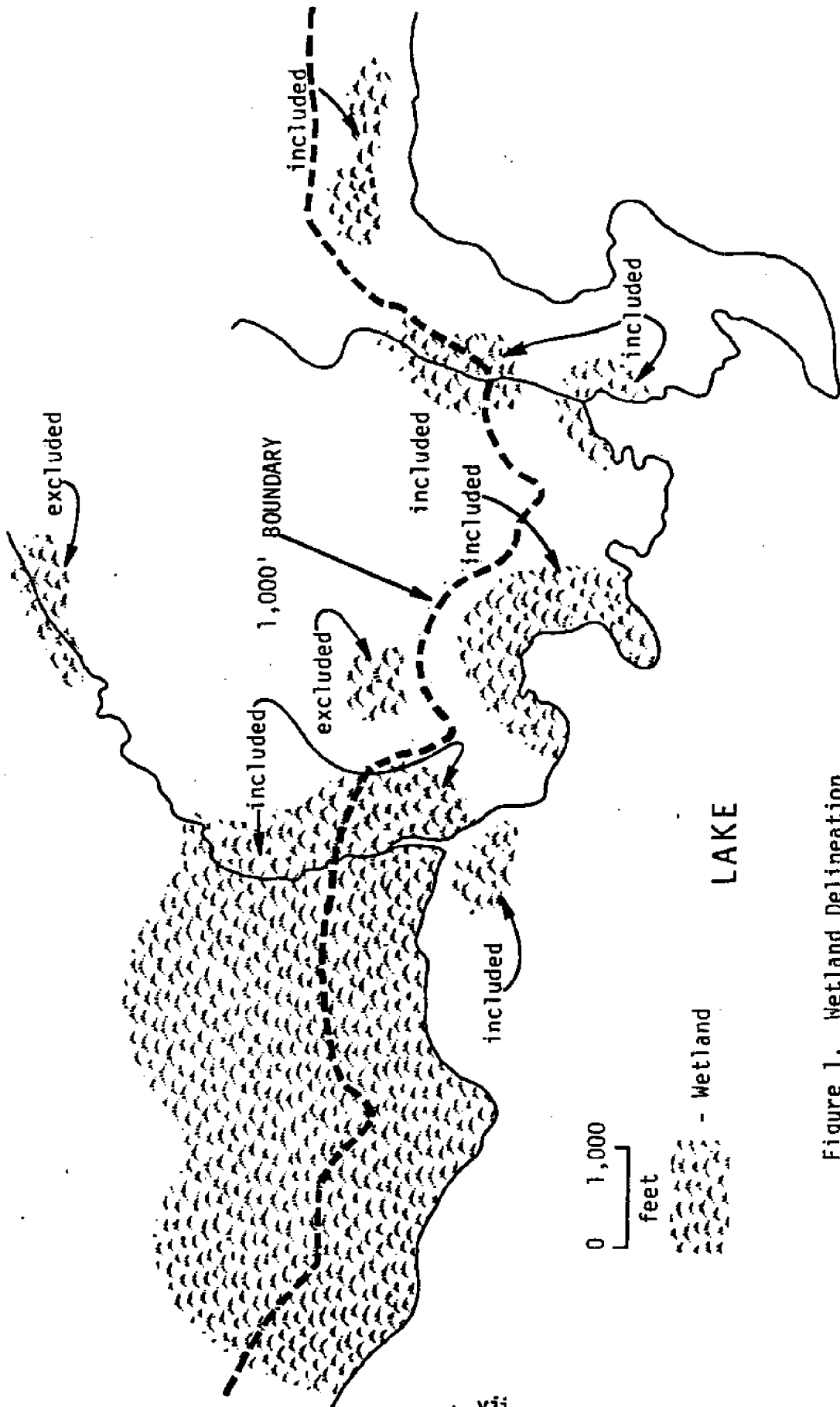


Figure 1. Wetland Delineation

Table 1. Fifteen Lake Sections of Lake Michigan

Lake section	Shoreline area included
1	Mackinaw City, Michigan, to Sevenmile Point, northwest of Harbor Springs
2	Sevenmile Point, northwest of Harbor Springs, to Cathead Point at the tip of Leelanau Peninsula
3	Cathead Point, at the tip of Leelanau Peninsula, to Lookout Point, north of Portage Lake
4	Lookout Point, north of Portage Lake, to the City of North Muskegon, Michigan
5	City of North Muskegon, Michigan, to the Allegan County - Van Buren County border
6	Allegan County - Van Buren County border to the Michigan - Indiana border
7	Michigan - Indiana border to East Chicago, Indiana
8	East Chicago, Indiana, to just north of the Illinois - Wisconsin border
9	Just north of the Illinois - Wisconsin border to the Door County - Kewaunee County border
10	Door County - Kewaunee County border to the Kewaunee County - Brown County border
11	Kewaunee County - Brown County border to the Wisconsin - Michigan border along the Menominee River
12	Wisconsin - Michigan border along the Menominee River to Escanaba, Michigan
13	Escanaba, Michigan, to just east of the Delta County - Schoolcraft County border near Point aux Barques
14	Just east of the Delta County - Schoolcraft County border near Point aux Barques to an area west of Naubinway, Michigan, near the Lower Millecoquins River
15	West of Naubinway, Michigan, near the Lower Millecoquins River to Point St. Ignace near the Mackinac Bridge

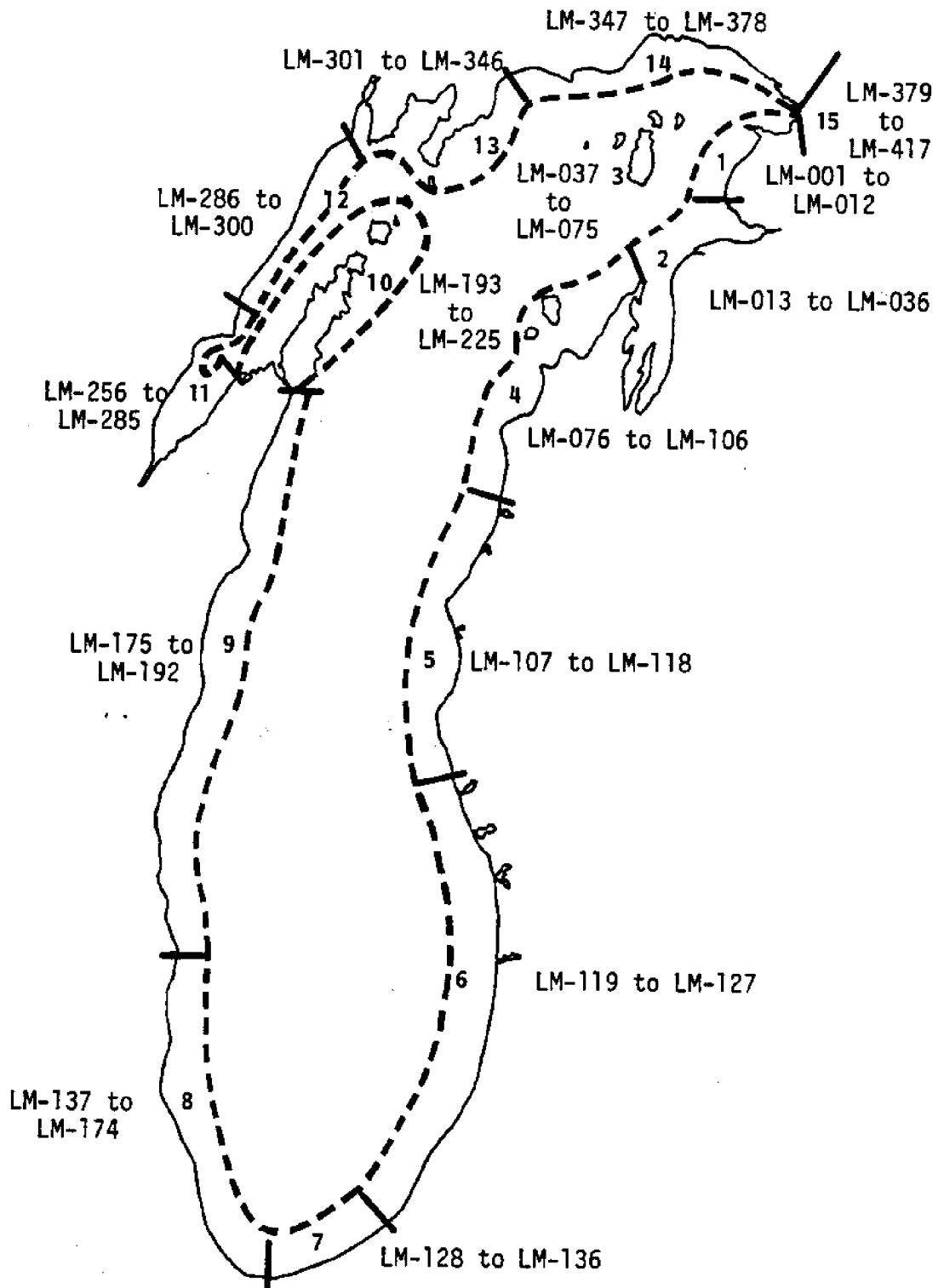


Figure 2. Lake Sections of Lake Michigan and The Straits of Mackinac

Table 2. Major components Addressed in Individual
Wetland Narratives

PHYSIOGRAPHIC SETTING

Setting
Topography
Surficial Geology
Soils
Hydrology
Climate
Special Features

BIOTIC SETTING

Vegetation
Fish
Invertebrates
Reptiles and Amphibians
Avifauna
Mammals
Endangered Species

CULTURAL SETTING

Demography
Land Use and Ownership
Recreation
Mineral, Energy, and Forest Resources
Public Utilities and Facilities
Pollution Sources
Historic and Archaeologic Features

RESEARCH PROJECTS

Wisconsin appears in Appendix F-1 of this volume. Scientific names associated with the common names used in this volume are presented in the Appendices of the Overview Volume.

A number of the wetlands along the Lake Michigan shoreline are situated in close proximity to one another and have been grouped into "complexes" for convenience of discussion. The grouping of several wetlands in a complex does not necessarily imply any physical or biological continuity among those wetlands, although such continuity may exist in some cases. Several small wetlands in close proximity to one another or to a single larger wetland may have little or no site-specific information associated with them. It is simpler to group them under a single narrative rather than provide a completely negative narrative for each separately. A complete listing of these complexes as well as the individual wetlands along the Lake Michigan shoreline is presented in Table 3. The table also indicates the page number on which a description of the wetland can be found.

This report is intended to provide a comprehensive summary of published information concerning the coastal wetlands of Lake Michigan that can be readily used by public institutions and agencies as well as private groups and individuals. This report should enable interested persons to more easily use existing information as well as to identify areas where information concerning coastal wetlands is lacking. Doubtless, some sources of published information have been overlooked. It is hoped that such information, however minor, will be relayed to the authors.

Table 3. Wetlands in Lake Michigan

Wetland Number	Wetland	Page Number
Lake Section 1		1
LM-001	Mackinaw City Wetland	4
LM-002	Johnson Point Wetland	9
LM-003	Trails End Bay Wetland	14
LM-004	Wa-Watum Point Wetland	19
LM-005	Carp Lake River Area Wetland	24
	CECIL BAY WETLAND COMPLEX	29
LM-006	Cecil Bay Wetland #1	
LM-007	Cecil Bay Wetland #2	
LM-008	Big Stone Point Wetland	35
LM-009	Waugoshance Point Wetland #1	41
LM-010	Waugoshance Point Wetland #2	46
LM-011	Waugoshance Island Wetland	52
LM-012	Little Sucker Creek Wetland	57
Lake Section 2		63
LM-013	West Traverse Township Wetland	67
LM-014	McGeach Creek Wetland	72
LM-015	Norwood Township Wetland	77
LM-016	Whiskey Creek Wetland	82
	BANKS TOWNSHIP WETLAND COMPLEX	87
LM-017	Banks Township Wetland #1	
LM-018	Banks Township Wetland #2	
LM-019	Banks Township Wetland #3	
LM-020	Torch Lake Township Wetland #1	93
LM-021	Torch Lake Township Wetland #2	98
LM-022	Torch Lake Township Wetland #3	103

-continued-

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-023	Torch Lake Township Wetland #4	108
LM-024	Milton Township Wetland #1	113
LM-025	Milton Township Wetland #2	118
LM-026	Paradise Creek Wetland	123
LM-027	TRANSVERSE CITY AREA WETLAND COMPLEX	128
LM-028	Transverse City Area Wetland #1	
	Transverse City Area Wetland #2	
LM-029	Peninsula Township Wetland #1	135
LM-030	PENINSULA TOWNSHIP AREA WETLAND COMPLEX	136
LM-031	Peninsula Township Wetland #2	
	Peninsula Township Wetland #3	
LM-032	Bowers Harbor Wetland	137
LM-033	Lee Point Wetland	142
LM-034	Suttons Bay Wetland	147
LM-035	Omena Wetland	152
LM-036	Ennis Creek Area Wetland	157
Lake Section 3		163
LM-037	Good Harbor Bay Wetland #1	167
LM-038	Good Harbor Bay Wetland #2	172
LM-039	Good Harbor Bay Wetland #3	177
LM-040	Port Oneida Wetland	182
LM-041	NORTH MANITOU ISLAND WETLAND COMPLEX	187
LM-042	Leland Township Wetland	
	Tamarack Lake Wetland	
LM-043	Gull Island Wetland	194

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-044	BEAVER ISLAND WETLAND COMPLEX (NORTH)	200
LM-045	Looney Point Wetland	
	Little Sandy Bay Wetland	
LM-046	BEAVER ISLAND WETLAND COMPLEX (SOUTH)	208
LM-047	Jordan River Wetland	
LM-048	Point La Par Wetland	
LM-049	Beaver Island Interior Wetland	
LM-050	Kelly Point Area Wetland	
	French Bay Wetland	
LM-051	HIGH ISLAND WETLAND COMPLEX	218
LM-052	High Island Wetland #1	
LM-053	High Island Wetland #2	
LM-054	High Island Wetland #3	
LM-055	High Island Wetland #4	
LM-056	High Island Wetland #5	
LM-057	High Island Wetland #6	
	High Island Wetland #7	
LM-058	HOG ISLAND WETLAND COMPLEX	225
LM-059	Hog Island Wetland #1	
LM-060	Hog Island Wetland #2	
LM-061	Hog Island Wetland #3	
LM-062	Hog Island Wetland #4	
LM-063	Hog Island Wetland #5	
LM-064	Hog Island Wetland #6	
LM-065	Hog Island Wetland #7	
LM-066	Hog Island Wetland #8	
LM-067	Hog Island Wetland #9	
LM-068	Hog Island Wetland #10	
	Hog Island Wetland #11	
LM-069	GARDEN ISLAND WETLAND COMPLEX	232
LM-070	Garden Island Wetland #1	
LM-071	Garden Island Wetland #2	
LM-072	Garden Island Wetland #3	
LM-073	Jensen Harbor Wetland	
	Northcutt Bay Wetland	
LM-074	Betsie River Wetland	238
LM-075	Arcadia Lake Wetland	245

Table 3. (continued)

Wetland Number	Wetland	Page Number
Lake Section 4		253
LM-076	Portage Lake Wetland	258
	BAR LAKE WETLAND COMPLEX	263
LM-077	Bar Lake Swamp	
LM-078	Bar Lake Wetland #1	
LM-079	Bar Lake Wetland #2	
LM-080	Manistee River Wetland	269
LM-081	Little Manistee River Wetland	277
LM-082	Filer/Grant Townships Wetland	282
LM-083	Big Sable Point Wetland	287
LM-084	Rupert Bayou Wetland	292
	HAMLIN LAKE AREA WETLAND COMPLEX	297
LM-085	Hamlin Lake Wetland #1	
LM-086	Hamlin Lake Wetland #2	
LM-087	Big Sable River Wetland	302
LM-088	Hamlin Lake Wetland #3	307
	HAMLIN LAKE WETLAND COMPLEX	312
LM-089	Hamlin Lake Wetland #4	
LM-090	Hamlin Lake Wetland #5	
LM-091	North Bayou Wetland	317
LM-092	Middle Bayou Wetland	322
LM-093	South Bayou Area Wetland	327
LM-094	Piney Ridge Area Wetland	328
LM-095	Pere Marquette River Wetland	333

-continued-

Table 3. (continued)

Wetland Number	Wetland	Page Number
	BASS LAKE WETLAND COMPLEX	342
LM-096	Kibby Creek Area Wetland	
LM-097	Bass Lake Wetland #1	
LM-098	Bass Lake Wetland #2	
LM-099	Pentwater Lake Wetland	348
LM-100	Pentwater River Wetland	353
LM-101	Richmonds Inlet Wetland	359
LM-102	Stony Creek Wetland	364
LM-103	Claybanks Township Wetland	369
LM-104	Flower Creek Wetland	374
LM-105	White River Wetland	379
LM-106	Duck Lake Wetland	385
Lake Section 5		391
LM-107	Devils Kitchen Wetland	395
LM-108	Green Creek Wetland	400
LM-109	Muskegon Lake Wetland	405
LM-110	Muskegon River Wetland	410
LM-111	Norton Shores Wetland	422
LM-112	Mona Lake Wetland	427
LM-113	Little Pigeon Creek Wetland	432
LM-114	Pigeon River Wetland	437
LM-115	Sloan Pond Wetland	442
	BIG BAY WETLAND COMPLEX	447
LM-116	Big Bay Wetland #1	
LM-117	Big Bay Wetland #2	
LM-118	Big Bay Wetland #3	

Table 3. (continued)

Wetland Number	Wetland	Page Number
Lake Section 6		453
LM-119	Black River Wetland	457
LM-120	Hagar Township Wetland #1	462
LM-121	Hagar Township Wetland #2	467
	GRAND MERE LAKES AREA WETLAND COMPLEX	472
LM-122	Grand Mere Lakes Wetland #1	
LM-123	Grand Mere Lakes Wetland #2	
LM-124	Grand Mere Lakes Wetland #3	
LM-125	Grand Mere Lakes Wetland #4	
LM-126	Harbert Wetland	482
LM-127	Gallen River Wetland	487
Lake Section 7		495
LM-128	Indiana Dunes Wetland	498
	DUNE ACRES WETLAND COMPLEX	512
LM-129	Dune Acres Wetland #1	
LM-130	Dune Acres Wetland #2	
	OGDEN DUNES WETLAND COMPLEX	522
LM-131	Ogden Dunes Wetland #1	
LM-132	Ogden Dunes Wetland #2	
LM-133	Ogden Dunes Wetland #3	
LM-134	Ogden Dunes Wetland #4	
LM-135	Ogden Dunes Wetland #5	
LM-136	Marquette Park Area Wetland	535

Table 3. (continued)

Wetland Number	Wetland	Page Number
Lake Section 8		542
	LAKE CALUMET WETLAND COMPLEX	546
LM-137	East Chicago Wetland	
LM-138	Lake George Wetland #1	
LM-139	Lake George Canal Wetland #1	
LM-140	Lake George Canal Wetland #2	
LM-141	Lake George Wetland #2	
LM-142	Lake George Canal Wetland #3	
LM-143	Wolf Lake Park Wetland #1	
LM-144	Wolf Lake Park Wetland #2	
LM-145	Wolf Lake Park Wetland #3	
LM-146	Wolf Lake Park Wetland #4	
LM-147	William W. Powers Conservation Area Wetland #1	
LM-148	William W. Powers Conservation Area Wetland #2	
LM-149	William W. Powers Conservation Area Wetland #3	
LM-150	Powder Horn Lake Wetland #1	
LM-151	Powder Horn Lake Wetland #2	
LM-152	Powder Horn Lake Wetland #3	
LM-153	Lake Calumet Wetland #1	
LM-154	Lake Calumet Wetland #2	
LM-155	Lake Calumet Wetland #3	
LM-156	Lake Calumet Wetland #4	
LM-157	Lake Calumet Wetland #5	
LM-158	Lake Calumet Wetland #6	
LM-159	Lake Calumet Wetland #7	
LM-160	Calumet River Turning Basin #5 Wetland #1	
LM-161	Calumet River Turning Basin #5 Wetland #2	
LM-162	O'Brien Lock and Dam Area Wetland #1	
LM-163	O'Brien Lock and Dam Area Wetland #2	
LM-164	O'Brien Lock and Dam Area Wetland #3	
LM-165	O'Brien Lock and Dam Area Wetland #4	
LM-166	O'Brien Lock and Dam Area Wetland #5	
LM-167	Grand Calumet River Mouth Wetland #1	
LM-168	Grand Calumet River Mouth Wetland #2	
LM-169	Grand Calumet River Mouth Wetland #3	
LM-170	Little Calumet River Wetland #1	
LM-171	Little Calumet River Wetland #2	
LM-172	Little Calumet River Wetland #3	

Table 3. (continued)

Wetland Number	Wetland	Page Number
	ILLINOIS BEACH STATE PARK WETLAND COMPLEX	570
LM-173	Waukegan Wetland	
LM-174	Illinois Beach State Park Wetland	
Lake Section 9		
LM-175	Dominican College Wetland	594
LM-176	Oak Creek Wetland	600
	CARROLLVILLE WETLAND COMPLEX	607
LM-177	Carrollville Wetland #1	
LM-178	Carrollville Wetland #2	
LM-179	Mequon Township Wetland	612
LM-180	Grafton Township Wetland	617
	WASHINGTON SCHOOL WETLAND COMPLEX	622
LM-181	Washington School Wetland #1	
LM-182	Washington School Wetland #2	
LM-183	Washington School Wetland #3	
LM-184	Mosel Township Wetland	628
LM-185	Point Beach State Forest Wetland	633
LM-186	Two Creeks Township Wetland #1	640
LM-187	Two Creeks Township Wetland #2	645
LM-188	Two Creeks Township Wetland #3	650
LM-189	Carlton Township Wetland	655
	KEWAUNEE RIVER WETLAND COMPLEX	660
LM-190	Kewaunee River Wetland #1	
LM-191	Kewaunee River Wetland #2	
LM-191 A	Pierce Township Wetland	668
LM-192	Threemile Creek Wetland	673

Table 3. (continued)

Wetland Number	Wetland	Page Number
Lake Section 10		679
	ROCKY POINT WETLAND COMPLEX	684
LM-193	Rocky Point Wetland	
LM-194	Sturgeon Bay Township Wetland	
LM-195	Sturgeon Bay Canal Wetland	
LM-196	Lilly Bay Wetland	690
	WHITEFISH BAY WETLAND COMPLEX	695
LM-197	Whitefish Bay Wetland	
LM-198	Whitefish Bay Creek Wetland	
LM-199	Jacksonport Area Wetland	702
	KANGAROO LAKE AREA WETLAND COMPLEX	707
LM-200	Kangaroo Lake Area Wetland #1	
LM-201	Kangaroo Lake Area Wetland #2	
LM-202	Baileys Harbor-Ephraim Swamp	713
LM-203	Toft Point Wetland	724
	CANA ISLAND AREA WETLAND COMPLEX	733
LM-204	Cana Island Area Wetland #1	
LM-205	Cana Island Area Wetland #2	
LM-206	North Bay Wetland	738
	ROWLEYS BAY WETLAND COMPLEX	748
LM-207	Rowleys Bay Wetland #1	
LM-208	Rowleys Bay Wetland #2	
LM-209	Liberty Grove Township Wetland #1	756
LM-210	Liberty Grove Township Wetland #2	763
LM-211	Europe Bay Wetland	770
	EUROPE LAKE WETLAND COMPLEX	775
LM-212	Europe Lake Wetland #1	
LM-213	Europe Lake Wetland #2	
LM-214	Plum Island Wetland	781
LM-215	Detroit Island Wetland	787

-continued-

xx

Table 3. (continued)

Wetland Number	Wetland	Page Number
	WASHINGTON ISLAND WETLAND COMPLEX	792
LM-216	Jackson Harbor Wetland #1	
LM-217	Jackson Harbor Wetland #2	
LM-218	South Point Wetland #1	
LM-219	South Point Wetland #2	
LM-220	Detroit Harbor Wetland #1	
LM-221	Detroit Harbor Wetland #2	
LM-222	West Harbor Area Wetland #1	
LM-223	West Harbor Area Wetland #2	
LM-224	Coffee Swamp	
LM-225	Coffee Swamp Area Wetland	
LM-226	Gills Rock Wetland	801
LM-227	Garret Bay Wetland	806
	ELLISON BAY WETLAND COMPLEX	811
LM-228	Ellison Bay Wetland #1	
LM-229	Ellison Bay Wetland #2	
	CHAMBERS ISLAND WETLAND COMPLEX	817
LM-230	Chambers Island Wetland #1	
LM-231	Chambers Island Wetland #2	
LM-232	Sister Bay Wetland	823
LM-233	Tennison Bay Wetland	828
LM-234	Juddville Bay Wetland	833
LM-235	Egg Harbor Wetland	838
LM-236	Leroys Point Wetland	843
	HORSESHOE POINT WETLAND COMPLEX	848
LM-237	Horseshoe Point Wetland	
LM-238	Monument Point Wetland #1	
LM-239	Monument Point Wetland #2	
LM-240	Egg Harbor Township Wetland	854
	SAWYER HARBOR WETLAND COMPLEX	859
LM-241	Sawyer Harbor Wetland #1	
LM-242	Sawyer Harbor Wetland #2	
LM-243	Sawyer Harbor Wetland #3	
LM-244	Sawyer Harbor Wetland #4	

-continued-

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-245	Sand Bay Area Wetland	866
	SAND BAY WETLAND COMPLEX	871
LM-246	Sand Bay Wetland #1	
LM-247	Sand Bay Wetland #2	
LM-248	Sand Bay Wetland #3	
LM-249	Snake Island Wetland	877
LM-250	Rileys Point Wetland	882
	LITTLE STURGEON BAY WETLAND COMPLEX	887
LM-251	Little Sturgeon Bay Wetland #1	
LM-252	Little Sturgeon Bay Wetland #2	
LM-253	Keyes Creek Wetland	
LM-254	Henderson Point Wetland	
LM-255	Gardner Township Wetland #1	894
Lake Section 11		901
LM-256	Scott Township Wetland	905
LM-256A	Point au Sable Wetland	910
LM-257	Whitney Slough	916
LM-258	Fox River Wetland	924
	ATKINSON MARSH COMPLEX	932
LM-259	Atkinson Marsh	
LM-260	Peats Lake Wetland #1	
LM-261	Peats Lake Wetland #2	
	DEAD HORSE BAY WETLAND COMPLEX	946
LM-262	Dead Horse Bay Wetland #1	
LM-263	Dead Horse Bay Wetland #2	
LM-264	Peter's Marsh	
LM-265	Dead Horse Bay Wetland #3	
LM-266	Dead Horse Bay Wetland #4	
LM-267	Dead Horse Bay Wetland #5	
LM-268	Dead Horse Bay Wetland #6	
LM-269	Dead Horse Bay Wetland #7	

Table 3. (continued)

Wetland Number	Wetland	Page Number
	LONG TAIL POINT WETLAND COMPLEX	959
LM-270	Dead Horse Bay Wetland #8	
LM-271	Dead Horse Bay Wetland #9	
LM-272	Long Tail Point Wetland #1	
LM-273	Long Tail Point Wetland #2	
	LITTLE TAIL POINT WETLAND COMPLEX	968
LM-274	Little Tail Point Wetland #1	
LM-275	Little Tail Point Wetland #2	
LM-276	Little Suamico Township Wetland	976
LM-277	Mud Creek Wetland	983
	CHARLES POND AREA WETLAND COMPLEX	990
LM-278	Kirchner Creek Area Wetland	
LM-279	Charles Pond Wetland	
	PENSAUKEE RIVER WETLAND COMPLEX	999
LM-280	Pensaukee River Wetland	
LM-281	Pensaukee River Area Wetland #1	
LM-282	Pensaukee River Area Wetland #2	
LM-283	Oconto Marsh	1007
LM-284	Peshtigo River Wetland	1019
LM-285	Seagull Bar Wetland	1030
Lake Section 12		1041
LM-286	Menominee River Wetland	1045
LM-287	Ingallston Township Wetland	1050
LM-288	Arthur Bay Wetland	1055
	CEDAR RIVER AREA WETLAND COMPLEX	1060
LM-289	Cedarville Township Wetland #1	
LM-290	Cedar River Wetland	
LM-291	Deer Creek Wetland	
LM-292	Fox Park Wetland	
LM-293	Cedarville Township Wetland #2	

-continued-

xxiii

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-294	Bark River Wetland	1069
LM-295	Henderson Lakes Wetland	1074
LM-296	North Lake Area Wetland	1079
	FORD RIVER AREA WETLAND COMPLEX	1084
LM-297	Ford River Township Wetland	
LM-298	Ford River Delta Wetland	
LM-299	Portage Marsh	1091
LM-300	Escanaba City Wetland	1099
Lake Section 13		1105
LM-301	Escanaba River Wetland	1110
LM-302	Escanaba Township Wetland	1116
LM-303	Saunders Point Wetland	1121
LM-304	Kipling Wetland	1126
LM-305	Days River Wetland	1131
	WHITEFISH RIVER AREA WETLAND COMPLEX	1136
LM-306	Masonville Wetland	
LM-307	Rapid River Wetland	
LM-308	Whitefish River Wetland #1	
LM-309	Whitefish River Wetland #2	
LM-310	Whitefish River Wetland #3	
LM-311	Squaw Point Wetland	1143
LM-312	Trinity Church Wetland	1149
	DEEPWATER POINT WETLAND COMPLEX	1154
LM-313	Deepwater Point Wetland #1	
LM-314	Deepwater Point Wetland #2	
LM-315	Peninsula Point Wetland	1160
LM-316	Wilsey Bay Wetland	1165
LM-317	Wedens Bay Wetland	1170

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-318 LM-319	GRANSKOG CREEK WETLAND COMPLEX Chippewa Point Wetland Granskog Creek Wetland	1175
LM-320 LM-321	SAND BAY WETLAND COMPLEX Sand Bay Wetland #1 Sand Bay Wetland #2	1181
LM-322 LM-323 LM-324 LM-325	MARTIN BAY WETLAND COMPLEX Martin Bay Wetland #1 Martin Creek Wetland Martin Bay Wetland #2 St. Vital Point Wetland	1186
LM-326	St. Vital Island Wetland	1192
LM-327 LM-328	OGONTZ BAY WETLAND COMPLEX Ogontz Bay Wetland #1 Ogontz Bay Wetland #2	1997
LM-329	Sturgeon River Wetland	1203
LM-330 LM-331	UPPER BIG BAY DE NOC WETLAND COMPLEX Upper Big Bay De Noc Wetland Jacks Bluff Wetland	1210
LM-332	Garden Bay Wetland	1217
LM-333 LM-334	PUFFY BAY WETLAND COMPLEX Puffy Bay Wetland #1 Puffy Bay Wetland #2	1222
LM-335	South River Bay Wetland	1228
LM-336	Point Detour Wetland	1233
LM-337	Sucker Lake Wetland	1238
LM-338 LM-339 LM-340	PORTAGE BAY AREA WETLAND COMPLEX Portage Bay Wetland #1 Portage Bay Wetland #2 Halfmoon Lake Wetland	1244
LM-341	Delta County Border Wetland	1251

Table 3. (continued)

Wetland Number	Wetland	Page Number
	POINT O'KEEFE AREA WETLAND COMPLEX	1256
LM-342	Point O'Keefe Wetland	
LM-343	Trail Creek Wetland	
	LITTLE HARBOR AREA WETLAND COMPLEX	1261
LM-344	Cole Point Wetland	
LM-345	Little Harbor Wetland	
LM-346	Pillows Point Wetland	
Lake Section 14		1269
LM-347	Stony Point Area Wetland	1273
LM-348	Manistique City Wetland	1279
LM-349	Manistique Township Wetland #1	1284
LM-350	Manistique Township Wetland #2	1289
	DUTCH JOHNS POINT AREA WETLAND COMPLEX	1294
LM-351	Manistique Township Wetland #3	
LM-352	Manistique Township Wetland #4	
LM-353	Manistique Township Wetland #5	
LM-354	Dutch Johns Point Wetland	
LM-355	Dry Creek Area Wetland	1300
	SEUL CHOIX POINT AREA WETLAND COMPLEX	1305
LM-356	Marblehead Creek Area Wetland #1	
LM-357	Marblehead Creek Area Wetland #2	
LM-358	Marblehead Creek Wetland	
LM-359	Gulliver Lake Wetland	
LM-360	Clear Lake Wetland	
LM-361	Seul Choix Bay Wetland #1	
LM-362	Seul Choix Bay Wetland #2	
LM-363	Port Inland Wetland	1314
	SEINERS POINT AREA WETLAND COMPLEX	1319
LM-364	Hughes Point Area Wetland	
LM-365	Seiners Point Wetland #1	
LM-366	Seiners Point Wetland #2	
	SWAN CREEK AREA WETLAND COMPLEX	1324
LM-367	Swan Creek Area Wetland #1	
LM-368	Swan Creek Area Wetland #2	

-continued-
xxvi

Table 3. (continued)

Wetland Number	Wetland	Page Number
LM-369	Peterson Creek Area Wetland #1	1329
LM-370	Peterson Creek Area Wetland #2	1334
	BIRCH POINT WETLAND COMPLEX	1339
LM-371	Birch Point Wetland #1	
LM-372	Birch Point Wetland #2	
	POINT PATTERSON AREA WETLAND COMPLEX	1344
LM-373	Scott Point Wetland	
LM-374	Point Patterson Wetland	
LM-375	Fox Point Area Wetland	1350
LM-376	McNeil Creek Wetland	1355
	GARFIELD TOWNSHIP WETLAND COMPLEX	1360
LM-377	Garfield Township Wetland #1	
LM-378	Garfield Township Wetland #2	
Lake Section 15		1366
LM-379	Lower Millecoquins River Area Wetland	1370
	MILLECOQUINS POINT AREA WETLAND COMPLEX	1375
LM-380	Millecoquins Point Area Wetland	
LM-381	Millecoquins Point Wetland	
	NAUBINWAY WETLAND COMPLEX	1380
LM-382	Naubinway Wetland #1	
LM-383	Naubinway Wetland #2	
LM-384	West Mile Creek Wetland	1385
LM-385	Mattix Creek Wetland	1390
	BIDDLE POINT WETLAND COMPLEX	1395
LM-386	Biddle Point Wetland #1	
LM-387	Biddle Point Wetland #2	
LM-388	Biddle Point Wetland #3	
LM-389	Biddle Point Wetland #4	

Table 3. (concluded)

Wetland Number	Wetland	Page Number
	BLACK RIVER BAY WETLAND COMPLEX	1401
LM-390	Black River Bay Wetland #1	
LM-391	Black River Bay Wetland #2	
LM-392	Black River Bay Wetland #3	
LM-393	Black River Bay Wetland #4	
LM-394	Hog Island Campground Wetland	1407
	HOG ISLAND POINT AREA WETLAND COMPLEX	1412
LM-395	Hog Island Point Wetland #1	
LM-396	Hog Island Point Wetland #2	
	DAVENPORT CREEK AREA WETLAND COMPLEX	1417
LM-397	Davenport Creek Area Wetland #1	
LM-398	Davenport Creek Area Wetland #2	
LM-399	Paquin Creek Wetland	1422
	EPOUFETTE AREA WETLAND COMPLEX	1427
LM-400	West Harbor Wetland	
LM-401	Kenyon Bay Wetland	
LM-402	Point Epoufette Wetland	
LM-403	Epoufette Bay Wetland #1	
LM-404	Epoufette Bay Wetland #2	
LM-405	Brevort Area Wetland	1434
	POINTE AUX CHENES WETLAND COMPLEX	1438
LM-406	Pointe Aux Chenes Bay Wetland #1	
LM-407	Pointe Aux Chenes Bay Wetland #2	
LM-408	Pointe Aux Chenes Bay Wetland #3	
LM-409	Pointe Aux Chenes Marshes	
	GROS CAP ROAD WETLAND COMPLEX	1445
LM-410	Gros Cap Road Wetland #1	
LM-411	Gros Cap Road Wetland #2	
LM-412	Gros Cap Road Wetland #3	
LM-413	Gros Cap Road Wetland #4	
LM-414	Gros Cap Road Wetland #5	
LM-415	West Moran Bay Wetland	1450
LM-416	St. Helena Island Wetland	1455
LM-417	Point St. Ignace Wetland	1459

LIST OF TABLES

		<u>Page No.</u>
Introduction		
Table 1.	Fifteen Lake Sections of Lake Michigan	viii
Table 2.	Major Components Addressed in Individual Wetland Narratives	x
Table 3.	Wetlands in Lake Michigan	xii
Lake Section 1		
Table 1-1.	Location, Acreage and Classification of Wetlands in Lake Section 1	3
Table 1-2.	Population Data for the Vicinity of Mackinaw City Wetland	7
Table 1-3.	Population Data for the Vicinity of Johnson Point Wetland	12
Table 1-4.	Population Data for the Vicinity of Trails End Bay Wetland	17
Table 1-5.	Population Data for the Vicinity of Wa-Watom Point Wetland	22
Table 1-6.	Population Data for the Vicinity of Carp Lake River Area Wetland	27
Table 1-7.	Population Data for the Vicinity of Cecil Bay Wetland #1 and #2	32
Table 1-8.	Birds Occurring in Big Stone Pond or Big Stone Pond Wetland	37
Table 1-9.	Population Data for the Vicinity of Big Stone Pond Wetland	39
Table 1-10.	Population Data for the Vicinity of Waugoshance Point Wetland #1	44
Table 1-11.	Birds Recorded at Waugoshance Point	48
Table 1-12.	Population Data for the Vicinity of Waugoshance Point Wetland #2	50
Table 1-13.	Population Data for the Vicinity of Little Sucker Creek Wetland	60
Table 1-14.	Data Gaps - Lake Section 1	62
Lake Section 2		
Table 2-1.	Location, Acreage and Classification of Wetlands in Lake Section 2	66
Table 2-2.	Population Data for the Vicinity of West Traverse Township Wetland	69
Table 2-3.	Population Data for the Vicinity of McGeach Creek Wetland	75
Table 2-4.	Population Data for the Vicinity of Norwood Township Wetland	80
Table 2-5.	Population Data for the Vicinity of Whiskey Creek Wetland	85

	<u>Page No.</u>	
Table 2-6.	Location of Banks Township Wetlands #1-#3	87
Table 2-7.	Elevations and Total Relief of Individual Wetlands in Banks Township	87
Table 2-8.	Population Data for the Vicinity of Banks Town- ship Wetlands #1-#3	91
Table 2-9.	Population Data for the Vicinity of Torch Lake Township Wetland #1	96
Table 2-10.	Population Data for the Vicinity of Torch Lake Township Wetland #2	101
Table 2-11.	Population Data for the Vicinity of Torch Lake Township Wetland #3	106
Table 2-12.	Population Data for the Vicinity of Torch Lake Township Wetland #4	111
Table 2-13.	Population Data for the Vicinity of Milton Town- ship Wetland #1	116
Table 2-14.	Population Data for the Vicinity of Milton Town- ship Wetland #2	121
Table 2-15.	Population Data for the Vicinity of Paradine Creek Wetland	126
Table 2-16.	Summary of the 1972-1976 Traverse City Christmas Bird Counts	131
Table 2-17.	Population Data for the Vicinity of Traverse City Area Wetlands #1 and #2	132
Table 2-18.	Population Data for the Vicinity of Bowers Harbor Wetland	140
Table 2-19.	Population Data for the Vicinity of Lee Point Wetland	145
Table 2-20.	Population Data for the Vicinity of Suttons Bay Wetland	150
Table 2-21.	Population Data for the Vicinity of Omnea Wetland	155
Table 2-22.	Population Data for the Vicinity of Ennis Creek Area Wetland	160
Table 2-23.	Data Gaps - Lake Section 2	162
Lake Section 3		
Table 3-1.	Location, Acreage and Classification of Wetlands in Lake Section 3	166
Table 3-2.	Population Data for the Vicinity of Good Harbor Bay Wetland #1	170
Table 3-3.	Population Data for the Vicinity of Good Harbor Bay Wetland #2	175
Table 3-4.	Population Data for the Vicinity of Good Harbor Bay Wetland #3	180
Table 3-5.	Population Data for the Vicinity of Port Oneida Wetland	185
Table 3-6.	Amphibians and Reptiles Documented on North Manitou Island	189
Table 3-7.	Annotated List of Birds Occurring on North Manitou Island	190

	<u>Page No.</u>
Table 3-8. Mammalian Species of North Manitou Island	191
Table 3-9. Birds Documented on Gull Island	197
Table 3-10. Amphibians and Reptiles Documented as Occurring on Beaver Island	202
Table 3-11. Birds Recorded on Beaver Island	203
Table 3-12. Location of Individual Wetlands in the Beaver Island Wetland Complex	208
Table 3-13. Elevations and Total Relief of Individual Wetlands in the Beaver Island Wetland Complex (South)	209
Table 3-14. Soil Types for the Individual Wetlands in the Beaver Island Wetland Complex (South)	210
Table 3-15. Amphibians and Reptiles Occurring in Beaver Island	212
Table 3-16. Birds Recorded on Beaver Island	214
Table 3-17. Elevations and Total Relief of Individual Wetlands in the High Island Wetland Complex	219
Table 3-18. Soil Types for the Individual Wetlands in High Island Wetland Complex	220
Table 3-19. Distance to Lakeshore of Hog Island Wetland Complex	225
Table 3-20. Elevations and Total Relief of Individual Wetlands in the Hog Island Wetland Complex	227
Table 3-21. Elevations and Total Relief of Individual Wetlands in the Garden Island Wetland Complex	233
Table 3-22. Mammalian Species of Garden Island	235
Table 3-23. Wetland Bird Species of the Beulah Census Area in the 1972 and 1974-1976 Christmas Bird Counts	241
Table 3-34. Common Mammalian Species of Betsie River Wetland	242
Table 3-25. Population Data for the Vicinity of Betsie River Wetland	243
Table 3-26. Estimated Waterfowl Production in Arcadia Wetlands	248
Table 3-27. Population Data for the Vicinity of Arcadia Lake Wetland	250
Table 3-28. Data Gaps - Lake Section 3	252
Lake Section 4	
Table 4-1. Location, Acreage and Classification of Wetlands in Lake Section 4	257
Table 4-2. Population Data for the Vicinity of Portage Lake Wetland	261
Table 4-3. Location of Individual Wetlands in the Bar Lake Wetland Complex	263
Table 4-4. Elevations and Total Relief of Individual Wetlands	264
Table 4-5. Population Data for the Vicinity of the Bar Lake Wetland Complex	267

Table 4-6.	Water Quality Data for the Manistee River Sampled One Mile Upstream from the River Mouth	270
Table 4-7.	Estimated Waterfowl Production and Migra- tional Use of Manistee River Wetland	273
Table 4-8.	Population Data for the Vicinity of Manistee River Wetland	274
Table 4-9.	Population Data for the Vicinity of Little Manistee River Wetland	280
Table 4-10.	Population Data for the Vicinity of Filer/ Grant Townships Wetland	285
Table 4-11.	Population Data for the Vicinity of Big Sable Point Wetland	290
Table 4-12.	Population Data for the Vicinity of Ruper Bayou Wetland	295
Table 4-13.	Population Data for the Vicinity of Hamlin Lake Wetlands #1 and #2	300
Table 4-14.	Population Data for the Vicinity of Big Sable River Wetland	305
Table 4-15.	Population Data for the Vicinity of Hamlin Lake Wetland #3	310
Table 4-16.	Population Data for the Vicinity of Hamlin Lake Wetlands #4 and #5	315
Table 4-17.	Population Data for the Vicinity of North Bayou Wetland	320
Table 4-18.	Population Data for the Vicinity of Middle Bayou Wetland	325
Table 4-19.	Population Data for the Vicinity of Piney Ridge Area Wetland	331
Table 4-20.	Fish Species Found in the Vicinity of Ludington, Mason County, Michigan	336
Table 4-21.	Estimated Waterfowl Production and Migrational Use of Pere Marquette River Wetland	337
Table 4-22.	Population Data for the Vicinity of Pere Marquette River Wetland	339
Table 4-23.	Population Data for the Vicinity of the Bass Lake Wetland Complex	345
Table 4-24.	Population Data for the Vicinity of Pentwater Lake Wetland	351
Table 4-25.	Estimated Waterfowl Production and Migrational Use of Pentwater River Wetland	356
Table 4-26.	Population Data for the Vicinity of Pentwater River Wetland	357
Table 4-27.	Population Data for the Vicinity of Richmonds Inlet Wetland	361
Table 4-28.	Population Data for the Vicinity of Stony Creek Wetland	367
Table 4-29.	Population Data for the Vicinity of Claybanks Township Wetland	372

	<u>Page No.</u>
Table 4-30. Population Data for the Vicinity of Flower Creek Wetland	377
Table 4-31. Population Data for the Vicinity of White River Wetland	382
Table 4-32. Population Data for the Vicinity of Duck Lake Wetland	387
Table 4-33. Data Gaps - Lake Section 4	389
Lake Section 5	
Table 5-1. Location, Acreage and Classification of Wetlands in Lake Section 5	394
Table 5-2. Population Data for the Vicinity of Devils Kitchen Wetland	398
Table 5-3. Population Data for the Vicinity of Green Creek Wetland	403
Table 5-4. Population Data for the Vicinity of Muskegon Lake Wetland	408
Table 5-5. Estimated Waterfowl Production and Migration for Muskegon River Wetland	413
Table 5-6. Seasonal Distribution of Birds in the Muskegon River Wetland During the Period September 1, 1962, through July 15, 1963	414
Table 5-7. Nesting Succession Eight 2.5 Acre Plots in Muskegon River Wetland	418
Table 5-8. Population Data for the Vicinity of Muskegon River Wetland	420
Table 5-9. Population Data for the Vicinity of Norton Shores Wetland	425
Table 5-10. Population Data for the Vicinity of Mona Lake Wetland	430
Table 5-11. Population Data for the Vicinity of Little Pigeon Creek Wetland	434
Table 5-12. Amphibians and Reptiles Identified on the Campbell Plant Site, Summer, 1972	439
Table 5-13. Population Data for the Vicinity of Pigeon River Wetland	440
Table 5-14. Population Data for the Vicinity of Sloan Pond Wetland	444
Table 5-15. Mammalian Species of the Macatawa River Basin	449
Table 5-16. Population Data for the Vicinity of Big Bay Wetlands #1 - #3	450
Table 5-17. Data Gaps - Lake Section 5	452
Lake Section 6	
Table 6-1. Location, Acreage and Classification of Wetlands in Lake Section 6	456
Table 6-2. Population Data for the Vicinity of Black River Wetland	460
Table 6-3. Population Data for the Vicinity of Hagar Township Wetland #1	464

Table 6-4.	Population Data for the Vicinity of Hagar Township Wetland #2	469
Table 6-5.	Locations of Grand Mere Lakes Wetlands #1-#4	472
Table 6-6.	Elevations and Total Relief of Individual Wetlands in the Grand Mere Lakes Area Wetland Complex	473
Table 6-7.	Amphibians and Reptiles Observed in the Grand Mere Area	476
Table 6-8.	Mammalian Species of the Grand Mere Area	478
Table 6-9.	Endangered, Threatened and Rare Species in the Grand Mere Area	479
Table 6-10.	Population Data for the Vicinity of the Grand Mere Lakes Area Wetland Complex	480
Table 6-11.	Population Data for the Vicinity of Harbert Wetland	485
Table 6-12.	Estimated Waterfowl Use of Galien River Wetland	490
Table 6-13.	Wetland Bird Species of the New Buffalo Census Area in the 1972-1975 Christmas Bird Counts	491
Table 6-14.	Population Data for the Vicinity of Galien River Wetland	492
Table 6-15.	Data Gaps - Lake Section 6	494
Lake Section 7		
Table 7-1.	Location, Acreage and Classification of Wetlands in Lake Section 7	497
Table 7-2.	Hydrologic Data for Markowitz Ditch and Indiana Dunes Wetland	500
Table 7-3.	Common to Abundant Birds Associating with Wetlands and with Recent Breeding Records from the Indiana Dunes National Lakeshore	504
Table 7-4.	Christmas Bird Counts from the Indiana Dunes National Lakeshore Census Area	505
Table 7-5.	Relative Abundance of Wetland Mammalian Species of the Indiana Dunes Region	508
Table 7-6.	Population Data for the Vicinity of Indiana Dunes Wetland	509
Table 7-7.	Key and Major Wetland Mammalian Species Present on the Bailly Nuclear-1 Study Site Near the Dune Acres Wetland Complex	517
Table 7-8.	Population Data for the Vicinity of the Dune Acres Wetland Complex	519
Table 7-9.	Water Quality Data for Ogden Dunes Wetlands #1-#5	524
Table 7-10.	1977 Fall Migration at the West Beach Unit of the Indiana Dunes National Lakeshore	528
Table 7-11.	Population Data for the Vicinity of the Ogden Dunes Wetland Complex	532
Table 7-12.	Population Data for the Vicinity of Marquette Park Area Wetland	539
Table 7-13.	Data Gaps - Lake Section 7	541

Lake Section 8

Table 8-1.	Location, Acreage and Classification of Wetlands in Lake Section 8	545
Table 8-2.	Locations of Lake Calumet Wetlands	551
Table 8-3.	Surficial Deposits and Soil Types for the Lake Calumet Wetland Complex	552
Table 8-4.	Water Quality Data for Wolf Lake Measured at the Indiana-Illinois State Line from January to June 1969	556
Table 8-5.	Water Quality for Wolf Lake Outlet at Carondelet Avenue from January to June 1969	556
Table 8-6.	Fishes Present in Lake Calumet and the Calumet River during the 1800's and early 1900's, currently Greatly Depleted or Extirpated	559
Table 8-7.	Wetland Bird Species of the Calumet City - Sandridge Census Area in the 1972-1976 Christmas Bird Count	562
Table 8-8.	Population Data for the Vicinity of the Lake Calumet Wetland Complex	565
Table 8-9.	Lake Calumet Wetland Complex Ownership	566
Table 8-10.	1966-1975 Surface Water Data for Illinois Beach State Park Wetland	573
Table 8-11.	1975-1976 Ground Water Data for Illinois Beach State Park Wetland	573
Table 8-12.	1975 Water Quality Data for Streams Entering Illinois Beach State Park Wetland	574
Table 8-13.	1975 Water Quality Data for Streams Leaving Illinois Beach State Park Wetland	574
Table 8-14.	Fishes of Bull Creek and Dead River, Lake County, Illinois	577
Table 8-15.	Waterfowl of the Waukegon Census Area in 1972-1976 Christmas Bird Counts	579
Table 8-16.	Major and Key Mammalian Species of Illinois Beach State Park	581
Table 8-17.	Population Data for the Vicinity of the Illinois Beach State Park Wetland Complex	583
Table 8-18.	Data Gaps - Lake Section 8	587

Lake Section 9

Table 9-1.	Location, Acreage and Classification of Wetlands in Lake Section 9	588
Table 9-2.	Amphibian and Reptile Records of Caledonia Township	596
Table 9-3.	Population Data for the Vicinity of Dominican College Wetland	598
Table 9-4.	Wetland Bird Species of the Hales Corner Census Area in the 1972-1976 Christmas Bird Counts	603
Table 9-5.	Population Data for the Vicinity of Oak Creek Wetland	604

Table 9-6.	Population Data for the Vicinity of Carrollville Wetland	610
Table 9-7.	Population Data for the Vicinity of Mequon Township Wetland	615
Table 9-8.	Population Data for the Vicinity of Grafton Township Wetland	620
Table 9-9.	Population Data for the Vicinity of Washington School Wetlands	626
Table 9-10.	Population Data for the Vicinity of Mosel Township Wetland	631
Table 9-11.	Reptiles and Amphibians in Point Beach State Forest Wetland	635
Table 9-12.	Population Data for the Vicinity of Point Beach State Forest Wetland	637
Table 9-13.	Population Data for the Vicinity of Two Creeks Township Wetland #1	643
Table 9-14.	Population Data for the Vicinity of Two Creeks Township Wetland #2	648
Table 9-15.	Population Data for the Vicinity of Two Creeks Township Wetland #3	653
Table 9-16.	Population Data for the Vicinity of Carlton Township Wetland	658
Table 9-17.	Water Quality for the Kewaunee River Taken at the River Mouth	661
Table 9-18.	Population Data for the Vicinity of Kewaunee River Wetland #2	665
Table 9-19.	Population Data for the Vicinity of Pierce Township Wetland	671
Table 9-20.	Population Data for the Vicinity of Threemile Creek Wetland	676
Table 9-21.	Data Gaps - Lake Section 9	678
Lake Section 10		
Table 10-1.	Location, Acreage and Classification of Wetlands in Lake Section 10	682
Table 10-2.	Population Data for the Vicinity of the Rocky Point Wetland Complex	688
Table 10-3.	Population Data for the Vicinity of Lilly Bay Wetland	693
Table 10-4.	Hydrological Data for Whitefish Bay Creek Sampled in 1965	696
Table 10-5.	Population Data for the Vicinity of the Whitefish Bay Wetland Complex	699
Table 10-6.	Population Data for the Vicinity of Jacksonport Area Wetland	705
Table 10-7.	Hydrological Data for Heines Creek Samples in 1962	708
Table 10-8.	Population Data for the Vicinity of Kangaroo Lake Area Wetland #1 and #2	711

Table 10-9.	Hydrological Data for Baileys Harbor-Ephraim Swamp Sampled in 1962	715
Table 10-10.	Flora of Baileys Harbor Bog	717
Table 10-11.	Mammalian Species of Ridges Sanctuary	720
Table 10-12.	Population Data for the Vicinity of Baileys Harbor-Ephraim	721
Table 10-13.	Breeding Bird Survey of Toft Point Scientific Area	727
Table 10-14.	Population Data for the Vicinity of Toft Point Wetland	730
Table 10-15.	Population Data for the Vicinity of Cana Island Area Wetlands #1 and #2	736
Table 10-16.	Hydrological Data for Three Springs Creek and Zoo Lake	739
Table 10-17.	Water Quality Data for North Bay Wetland and North Bay	740
Table 10-18.	Breeding Bird Survey of North Bay Wetland	743
Table 10-19.	Population Data for the Vicinity of North Bay Wetland	745
Table 10-20.	Hydrologic Data for the Mink River Sampled in 1969	749
Table 10-21.	Birds Recorded at the Proposed Mink River Marsh Area on June 2, 1970	752
Table 10-22.	Population Data for the Vicinity of Rowleys Bay Wetlands #1 and #2	754
Table 10-23.	Breeding Bird Survey of Newport State Park Conifer-Hardwoods, July 9, 1971	759
Table 10-24.	Population Data for the Vicinity of Liberty Grove Township Wetland #1	761
Table 10-25.	Breeding Bird Survey of Newport State Park Conifer-Hardwoods, July 9, 1971	766
Table 10-26.	Population Data for the Vicinity of Liberty Grove Township Wetland #2	767
Table 10-27.	Population Data for the Vicinity of Europe Bay Wetland	773
Table 10-28.	Population Data for the Vicinity of Europe Lake Wetlands #1 and #2	778
Table 10-29.	Breeding Bird Survey of Plum Island	784
Table 10-30.	Population Data for the Vicinity of Plum Island Wetland	785
Table 10-31.	Population Data for the Vicinity of Detroit Island Wetland	790
Table 10-32.	Locations of Washington Island Wetlands	793
Table 10-33.	Mammalian Species of Washington Island Which May Utilize Wetlands	797
Table 10-34.	Population Data for the Vicinity of the Washington Island Wetland Complex	798
Table 10-35.	Population Data for the Vicinity of Gills Rock Wetland	804
Table 10-36.	Population Data for the Vicinity of Garret Bay Wetland	809
Table 10-37.	Population Data for the Vicinity of the Ellison Bay Wetland Complex	814

Table 10-38.	Mammalian Species of Chambers Island	819
Table 10-39.	Population Data for the Vicinity of Chambers Island Wetlands #1 and #2	820
Table 10-40.	Population Data for the Vicinity of Sister Bay Wetland	826
Table 10-41.	Population Data for the Vicinity of Tennison Bay Wetland	831
Table 10-42.	Population Data for the Vicinity of Juddville Bay Wetland	836
Table 10-43.	Population Data for the Vicinity of Egg Harbor Wetland	841
Table 10-44.	Population Data for the Vicinity of Leroy Point Wetland	846
Table 10-45.	Location of Wetlands in the Horseshoe Point Wetland Complex	848
Table 10-46.	Population Data for the Vicinity of the Horseshoe Point Wetland Complex	852
Table 10-47.	Population Data for the Vicinity of Egg Harbor Township Wetland	857
Table 10-48.	Location of Sawyer Harbor Wetlands #1 - #4	859
Table 10-49.	Population Data for the Vicinity of Sawyer Harbor Wetlands #1 - #4	863
Table 10-50.	Population Data for the Vicinity of Sand Bay Area Wetland	869
Table 10-51.	Population Data for the Vicinity of the Sand Bay Area Wetland	874
Table 10-52.	Population Data for the Vicinity of Snake Island Wetland	880
Table 10-53.	Population Data for the Vicinity of Rileys Point Wetland	885
Table 10-54.	Location of the Wetlands in the Little Sturgeon Bay Wetland Complex	887
Table 10-55.	Soil Types in the Little Sturgeon Bay Wetland Complex	888
Table 10-56.	Hydrologic Data for Keyes Creek	889
Table 10-57.	Population Data for the Vicinity of Little Sturgeon Bay	892
Table 10-58.	Population Data for the Vicinity of Gardner Township Wetland	897
Table 10-59.	Data Gaps - Lake Section 10	899
Lake Section 11		
Table 11-1.	Location, Acreage and Classification of Wetlands in Lake Section 11	904
Table 11-2.	Population Data for the Vicinity of Scott Township Wetland	908
Table 11-3.	Water Quality Data for Green Bay Sampled Off Point au Sable	911
Table 11-4.	Population Data for the Vicinity of Point au Sable Wetland	914

	<u>Page No.</u>
Table 11-5. Mammals of Whitney Slough	920
Table 11-6. Population Data for the Vicinity of Whitney Slough	921
Table 11-7. Major Fish Species Found in the Lower Fox River, Brown County, Wisconsin	927
Table 11-8. Population Data for the Vicinity of Fox River Wetland	929
Table 11-9. Water Quality Data for Green Bay Sampled above Atkinson Marsh	934
Table 11-10. Water Quality Data for Peats Lake Sampled in September 1969	935
Table 11-11. Invertebrates Collected from Atkinson Marsh on April 22 and June 30, 1971	936
Table 11-12. Zooplankton Collected from Atkinson Marsh on April 22 and June 30, 1971	937
Table 11-13. Bird Census of Atkinson Marsh in 1969	940
Table 11-14. Mammalian Species Associated with the "Green Bay Diked Disposal Area" and Adjacent Wetlands	941
Table 11-15. Population Data for the Vicinity of Atkinson Marsh and Peats Lake Wetland #1 and #2	942
Table 11-16. Location of Dead Horse Bay Wetlands #1 - #7 and Peters Marsh	946
Table 11-17. Soils Series for Dead Horse Bay Wetland Complex	947
Table 11-18. Water Quality for Green Bay Sampled Near Dead Horse Bay Wetlands #1 and #2	948
Table 11-19. Water Quality Data for Peters Marsh Sampled on September 4, 1969	949
Table 11-20. Nesting Records of the Double-crested Cormorant Colony in Dead Horse Bay Wetland #1	951
Table 11-21. Nest Success, Eggs, and Young of Yellow-headed Blackbirds	953
Table 11-22. Population Data for the Vicinity of Dead Horse Bay Wetlands #1 - #7 and Peters Marsh	956
Table 11-23. Water Quality Data for Dead Horse Bay	961
Table 11-24. Population Data for the Vicinity of the Long Tail Point Wetland Complex	965
Table 11-25. Water Quality Data for Green Bay Sampled Near Little Tail Point	970
Table 11-26. Population Data for the Vicinity of Little Tail Point Wetlands #1 and #2	973
Table 11-27. Water Quality Data for Green Bay Sampled Near Little Tail Point	977
Table 11-28. Population Data for the Vicinity of Little Saumico Township Wetland	980
Table 11-29. Water Quality Data for Green Bay Sampled Above Little Tail Point	984
Table 11-30. Population Data for the Vicinity of Mud Creek Wetland	987
Table 11-31. Water Quality Data for Charles Pond	991

Table 11-32.	Water Quality Data for Green Bay Sampled Near Charles Pond	992
Table 11-33.	Bird Observations of Charles Pond Wetland in 1969	995
Table 11-34.	Population Data for the Vicinity of Charles Pond Wetland and Kirchner Creek Area Wetland	996
Table 11-35.	Water Quality Data for Green Bay Sampled Near the Pensaukee River Wetland Complex	1001
Table 11-36.	Population Data for the Vicinity of the Pensaukee River Wetland Complex	1004
Table 11-37.	Water Quality Data for Oconto Marsh Sampled July 17, 1969	1009
Table 11-38.	Water Quality Data for the Oconto River Sampled at River Mile 1.3	1009
Table 11-39.	Water Quality Data for Green Bay Sampled Offshore of Oconto Marsh	1010
Table 11-40.	Wetland Bird Species of the Peshtigo Census Area in the 1972-1976 Christmas Bird Counts	1014
Table 11-41.	Population Data for the Vicinity of Oconto Marsh	1016
Table 11-42.	Water Quality Data for Green Bay Sampled Offshore of Peshtigo River Wetland	1021
Table 11-43.	Breeding Birds of Peshtigo River Wetland	1024
Table 11-44.	Bird Observations at Peshtigo River Wetland	1025
Table 11-45.	Population Data for the Vicinity of Peshtigo River Wetland	1027
Table 11-46.	Water Quality Data for Seagull Bar Wetland	1031
Table 11-47.	Water Quality Data for Green Bay Sampled at Seagull Bar Wetland	1032
Table 11-48.	Bird Observations on Seagull Bar Wetland During 1969	1034
Table 11-49.	Breeding Birds of Seagull Bar	1036
Table 11-50.	Population Data for the Vicinity of Seagull Bar Wetland	1038
Table 11-51.	Data Gaps - Lake Section 11	1040
Lake Section 12		
Table 12-1.	Location, Acreage and Classification of Wetlands in Lake Section 12	1044
Table 12-2.	Population Data for the Vicinity of Menominee River Wetland	1048
Table 12-3.	Population Data for the Vicinity of Ingallston Township Wetland	1053
Table 12-4.	Population Data for the Vicinity of Arthur Bay Wetland	1058
Table 12-5.	Location of Cedar River Area Wetland Complex	1060
Table 12-6.	Elevation and Total Relief of Individual Wetlands in Cedar River Area Wetland Complex	1061
Table 12-7.	Soil Types for the Wetlands in Cedar River Area Wetland Complex	1062

	<u>Page No.</u>
Table 12-8. Estimated Waterfowl Breeding Activity at Cedar River Wetland	1065
Table 12-9. Population Data for the Vicinity of Cedar River Area Wetland	1066
Table 12-10. Population Data for the Vicinity of Bark River Wetland	1072
Table 12-11. Population Data for the Vicinity of Henderson Lakes Wetland	1077
Table 12-12. Population Data for the Vicinity of North Lake Area Wetland	1082
Table 12-13. Seasonal Bird Use of the Ford River Area Wetland Complex	1087
Table 12-14. Population Data for the Vicinity of the Ford River Area Wetland Complex	1088
Table 12-15. Estimated Waterfowl Breeding Activity and Majority Use of Portage Marsh	1095
Table 12-16. Population Data for the Vicinity of Portage Marsh	1096
Table 12-17. Population Data for the Vicinity of Escanaba City Wetland	1102
Table 12-18. Data Gaps - Lake Section 12	1104
Lake Section 13	
Table 13-1. Location, Acreage and Classification of Wetlands in Lake Section 13	1108
Table 13-2. Population Data for the Vicinity of Escanaba River Wetland	1113
Table 13-3. Population Data for the Vicinity of Escanaba Township Wetland	1119
Table 13-4. Population Data for the Vicinity of Saunders Point Wetland	1124
Table 13-5. Population Data for the Vicinity of Kipling Wetland	1129
Table 13-6. Population Data for the Vicinity of Days River Wetland	1134
Table 13-7. Elevations and Total Relief of Individual Wetlands in the Whitefish River Area Wetland Complex	1136
Table 13-8. Population Data for the Vicinity of Whitefish River Area Wetland Complex	1140
Table 13-9. Population Data for the Vicinity of Squaw Point Wetland	1147
Table 13-10. Population Data for the Vicinity of Trinity Church Wetland	1152
Table 13-11. Population Data for the Vicinity of Deepwater Point Wetland Complex	1157
Table 13-12. Population Data for the Vicinity of Peninsula Point Wetland	1163
Table 13-13. Population Data for the Vicinity of Wilsey Bay Wetland	1168

Table 13-14.	Population Data for the Vicinity of Wedens Bay Wetland	1173
Table 13-15.	Population Data for the Vicinity of Grandskog Creek Wetland Complex	1178
Table 13-16.	Population Data for the Vicinity of Sand Bay Wetlands #1 and #2	1184
Table 13-17.	Elevations and Total Relief of Individual Wetlands in Martin Bay Wetland Complex	1186
Table 13-18.	Soil Types for the Wetlands in the Martin Bay Wetland Complex	1187
Table 13-19.	Population Data for the Vicinity of Martin Bay Wetland Complex	1190
Table 13-20.	Population Data for the Vicinity of Ogontz Bay Wetlands #1 and #2	1201
Table 13-21.	Population Data for the Vicinity of Sturgeon River Wetland	1207
Table 13-22.	Population Data for the Vicinity of the Upper Big Bay De Noc Wetland Complex	1214
Table 13-23.	Population Data for the Vicinity of Garden Bay Wetland	1220
Table 13-24.	Population Data for the Vicinity of Puffy Bay Wetlands #1 and #2	1226
Table 13-25.	Population Data for the Vicinity of South River Bay Wetland	1231
Table 13-26.	Population Data for the Vicinity of Point Detour Wetland	1236
Table 13-27.	Population Data for the Vicinity of Sucker Lake Wetland	1241
Table 13-28.	Elevations and Total Relief of Individual Wetlands in the Portage Bay Area Wetland Complex	1244
Table 13-29.	Population Data for the Vicinit of the Portage Bay Area Wetland Complex	1248
Table 13-30.	Population Data for the Vicinity of Delta County Border Wetland	1254
Table 13-31.	Population Data for the Vicinity of Point O'Keefe Wetland and Trail Creek Wetland	1259
Table 13-32.	Elevations and Total Relief of Individual Wetlands in the Little Harbor Area Wetland Complex	1261
Table 13-33.	Population Data for the Vicinity of the Little Harbor Area Wetland Complex	1265
Table 13-34.	Data Gaps - Lake Section 13	1267
Lake Section 14		
Table 14-1.	Location, Acreage and Classification of Wetlands in Lake Section 14	1272
Table 14-2.	Population Data for the Vicinity of Stony Point Area Wetland	1276

Table 14-3.	Population Data for the Vicinity of Manistique City Wetland	1282
Table 14-4.	Population Data for the Vicinity of Manistique Township Wetland #1	1287
Table 14-5.	Population Data for the Vicinity of Manistique Township Wetland #2	1292
Table 14-6.	Soil Types for the Individual Wetlands in the Dutch Johns Point Area Wetland Complex	1295
Table 14-7.	Population Data for the Vicinity of Dutch Johns Point Area Wetland Complex	1298
Table 14-8.	Population Data for the Vicinity of Dry Creek Area Wetland	1303
Table 14-9.	Location of Individual Wetlands in Seul Choix Point Area Wetland Complex	1305
Table 14-10.	Elevations and Total Relief of Individual Wetlands in the Seul Choix Point Area Wetland Complex	1306
Table 14-11.	Fish Species and Relative Abundance in Gulliver Lake, Schoolcraft County, Michigan	1308
Table 14-12.	Population Data for the Vicinity of the Seul Choix Point Area Wetland Complex	1311
Table 14-13.	Population Data for the Vicinity of Port Inland Wetland	1317
Table 14-14.	Population Data for the Vicinity of the Seiners Point Area Wetland Complex	1322
Table 14-15.	Population Data for the Vicinity of Swan Creek Area Wetlands #1 and #2	1327
Table 14-16.	Population Data for the Vicinity of Peterson Creek Area Wetland #1	1332
Table 14-17.	Population Data for the Vicinity of Peterson Creek Area Wetland #2	1337
Table 14-18.	Population Data for the Vicinity of Birch Point Wetlands #1 and #2	1342
Table 14-19.	Population Data for the Vicinity of Scott Point Wetland and Point Patterson Wetland	1347
Table 14-20.	Population Data for the Vicinity of Fox Point Area Wetland	1353
Table 14-21.	Population Data for the Vicinity of McNeil Creek Wetland	1358
Table 14-22.	Population Data for the Vicinity of Garfield Township Wetlands #1 and #2	1363
Table 14-23.	Data Gaps - Lake Section 14	1365

Lake Section 15

Table 15-1.	Location, Acreage and Classification of Wetlands in Lake Section 15	1369
Table 15-2.	Population Data for the Vicinity of Lower Millecoquins River Area Wetland	1373
Table 15-3.	Population Data for the Vicinity of the Millecoquins Point Area Wetland Complex	1378

	<u>Page No.</u>
Table 15-4. Population Data for the Vicinity of the Naubinway Wetland Complex	1383
Table 15-5. Population Data for the Vicinity of West Mile Creek Wetland	1387
Table 15-6. Population Data for the Vicinity of Mattix Creek Wetland	1393
Table 15-7. Location of Individual Wetlands in the Biddle Point Wetland Complex	1395
Table 15-8. Elevations and Total Relief of Individual Wetlands in the Biddle Point Wetland Complex	1396
Table 15-9. Population Data for the Vicinity of Biddle Point Wetlands #1 - #4	1399
Table 15-10. Location of Individual Wetlands in the Black River Bay Wetland Complex	1401
Table 15-11. Elevations and Total Relief of Individual Wetlands in the Black River Bay Wetland Complex	1402
Table 15-12. Population Data for the Vicinity of the Black River Bay Wetlands #1 - #4	1405
Table 15-13. Population Data for the Vicinity of Hog Island Campground Wetland	1410
Table 15-14. Population Data for the Vicinity of Hog Island Point Wetlands #1 and #2	1415
Table 15-15. Population Data for the Vicinity of Davenport Creek Area Wetlands #1 and #2	1420
Table 15-16. Population Data for the Vicinity of Paquin Creek Wetland	1425
Table 15-17. Location of Individual Wetlands of the Epoufette Bay Wetland Complex	1427
Table 15-18. Waterfowl of Epoufette Bay Wetland #2	1430
Table 15-19. Population Data for the Vicinity of the Epoufette Bay Wetland Complex	1431
Table 15-20. Population Data for the Vicinity of Brevort Area Wetland	1436
Table 15-21. Location of Individual Wetlands in the Pointe Aux Chenes Wetland Complex	1438
Table 15-22. Elevations and Total Relief of Individual Wetlands in the Pointe Aux Chenes Wetland Complex	1439
Table 15-23. Population Data for the Vicinity of Pointe Aux Chenes Wetland Complex	1442
Table 15-24. Location of Individual Wetlands in the Gros Cap Road Wetland Complex	1445
Table 15-25. Population Data for the Vicinity of Gros Cap Road Wetlands #1 - #5	1448
Table 15-26. Population Data for the Vicinity of West Moran Bay Wetland	1452
Table 15-27. Population Data for the Vicinity of Point St. Ignace Wetland	1461
Table 15-28. Data Gaps - Lake Section 15	1463

LIST OF FIGURES

	<u>Page No.</u>
Figure 1. Wetland Delineation	vii
Figure 2. Lake Sections of Lake Michigan and The Straits of Mackinac	ix
Figure 1-1. Lake Section 1	2
Figure 2-1. Lake Section 2 - Little Traverse Bay Area	64
Figure 2-2. Lake Section 2 - Grand Traverse Bay Area	65
Figure 3-1. Lake Section 3 - Manitou Island Area	164
Figure 3-2. Lake Section 3 - Beaver Island Area	165
Figure 4-1. Lake Section 4 - Manistee National Forest Area	254
Figure 4-2. Lake Section 4 - Ludington Area	255
Figure 4-3. Lake Section 4 - Little Sable Point Area	256
Figure 5-1. Lake Section 5 - Muskegon Area	392
Figure 5-2. Lake Section 5 - Holland Area	393
Figure 6-1. Lake Section 6 - Benton Harbor Area	454
Figure 6-2. Lake Section 6 - Warren Dunes State Park Area	455
Figure 7-1. Lake Section 7	496
Figure 8-1. Northern Portion of Lake Section 8	543
Figure 8-2. Southern Portion of Lake Section 8	544
Figure 8-3. Detailed Map of Lake Calumet Wetland Complex	547
Figure 8-4. Detailed Map of Lake Calumet Wetland Complex	548
Figure 8-5. Detailed Map of Lake Calumet Wetland Complex	549
Figure 8-6. Detailed Map of Lake Calumet Wetland Complex	550
Figure 9-1. Lake Section 9 - South Milwaukee Area	589
Figure 9-2. Lake Section 9 - Port Washington Area	590
Figure 9-3. Lake Section 9 - Manitowoc Area	591
Figure 9-4. Lake Section 9 - Kewaunee Area	592
Figure 10-1. Lake Section 10 - Sturgeon Bay Area	680
Figure 10-2. Lake Section 10 - North Door County Area	681
Figure 11-1. Lake Section 11 - South Green Bay Area	902
Figure 11-2. Lake Section 11 - North Green Bay Area	903
Figure 12-1. Lake Section 12 - South Menominee State Forest Area	1042
Figure 12-2. Lake Section 12 - North Menominee State Forest Area	1043
Figure 13-1. Lake Section 13 - Big Bay DeNoc Area	1106
Figure 13-2. Lake Section 13 - South Manistique River State Forest Area	1107
Figure 14-1. Lake Section 14 - Manistique Area	1270
Figure 14-2. Lake Section 14 - Mackinac State Forest Area	1271
Figure 15-1. Lake Section 15 - Naubinway Area	1367
Figure 15-2. Lake Section 15 - Hiawatha National Forest Area	1368

LAKE SECTION 1

INTRODUCTION

Lake Section 1 extends along the northeastern shoreline of Lake Michigan from Mackinaw City to Sevenmile Point, northwest of Harbor Springs. The lake section is situated entirely within Emmet County, Michigan, which is sparsely populated. The wetlands of Lake Section 1 lie on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands are common in low inland areas on this plain. The predominant shore type in the vicinity of the wetlands is erodible low plain featuring a sand and gravel beach (Great Lakes Basin Commission, 1975).

Figure 1-1 shows the approximate location of the 12 wetlands in Lake Section 1. Latitude, longitude, acreage, and classification for each of these wetlands are presented in Table 1-1. Elevations of the wetlands in Lake Section 1 range from 580 to 615 feet above sea level (lake level to 35 feet above the approximate mean elevation of Lake Michigan). The majority of the wetlands are Palustrine systems. Lacustrine wetlands are also common.

Information related to the physiographic and cultural features of the 12 wetlands is summarized in the individual wetland narratives presented in this chapter. With the exception of Trails End Bay Wetland and Big Stone Pond Wetland, published sources have not provided site-specific information on the biotic characteristics of Section 1 wetlands. Information on the hydrologic characteristics of these wetlands is also lacking.

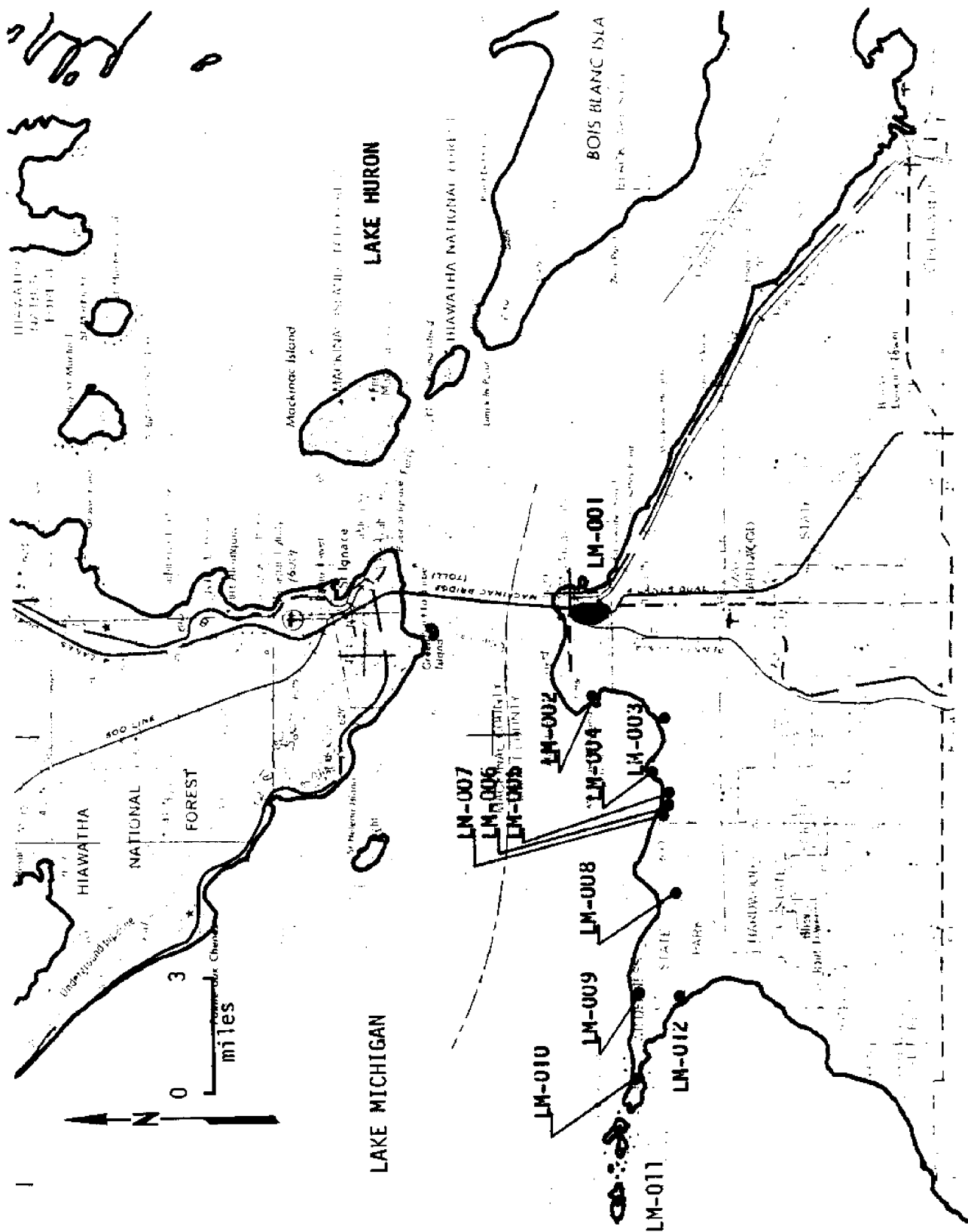


Figure 1-1. Lake Section 1

Table 1-1. Location, Acreage, and Classification of Wetlands
in Lake Section 1

Wetland Number	Wetland	Latitude	Longitude	Acreage	Classification ^a
001	Mackinaw City Wetland	45°46'40"	84°44'25"	189	P
002	Johnson Point Wetland	45°46'20"	84°46'53"	9	P
003	Trails End Bay Wetland	45°44'40"	84°47'40"	369	P,R
004	Wa-Watum Point Wetland	45°45'20"	84°49'50"	7	L
005	Carp Lake River Area Wetland	45°44'30"	84°50'00"	29	P
	CECIL BAY WETLAND COMPLEX				
006	Cecil Bay Wetland #1	45°44'40"	84°50'30"	10	L
007	Cecil Bay Wetland #2	45°44'40"	84°51'30"	38	P
008	Big Stone Pond Wetland	45°44'20"	84°53'40"	185	P,R
009	Waugoshance Point Wetland #1	45°45'20"	84°56'42"	9	P
010	Waugoshance Point Wetland #2	45°45'22"	84°59'50"	7	L
011	Waugoshance Island Wetland	45°45'15"	85°01'45"	10	L
012	Little Sucker Creek Wetland	45°44'20"	84°56'40"	259	P,R

^aP=palustrine
L=lacustrine
R=riverine

MACKINAW CITY WETLAND

PHYSIOGRAPHIC SETTING

LM 001

Setting

Mackinaw City Wetland is located approximately 0.2 mile from the Lake Michigan shoreline in Emmet County, Michigan, adjacent to Mackinaw City. The wetland is a Palustrine System and occupies a raised, partially wooded site. Portions of the wetland have been altered by construction of a rail line, absorption ponds, a transmission corridor, and Interstate Highway 75 (U.S.G.S. quadrangle map, St. Ignace, Michigan, 1964; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Mackinaw City Wetland is 10 feet; wetland elevations range from 600 to 610 feet above sea level (20 to 30 feet above the approximate mean elevation of Lake Michigan). The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Mackinaw City Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Mackinaw City Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Mackinaw City Wetland is Tawas muck, which has a surface layer consisting of black muck underlain by dark gray and dark brown muck and sand. Tawas muck was formed from woody and fibrous organic matter and decomposed wood. This soil is poorly drained and has moderate available water capacity and low natural fertility (Alfred et al., 1973).

Hydrology

There are no streams flowing through Mackinaw City Wetland, but a small lake is located near its center (U.S.G.S. quadrangle map, St. Ignace, Michigan, 1964). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, and seasonal changes in Mackinaw City Wetland.

Climate

The closest weather station providing climatic data for Mackinaw City Wetland is located in Mackinaw City, Michigan. Based on the normal period from

1931-1960, the mean monthly low for January is 14.6°F and the mean monthly high for July is 66.9°F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28°F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are found in the vicinity of Mackinaw City Wetland (U.S.G.S. quadrangle map, St. Ignace, Michigan, 1964; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 001

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Mackinaw City Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Mackinaw City Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Mackinaw City Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Mackinaw City Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of

the relevance of this information to Mackinaw City Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Mackinaw City Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Mackinaw City Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, two NPDES permit holders discharge waste in the vicinity of this wetland, which may have some affect on its health.

CULTURAL SETTING

LM 001

Population

Mackinaw City Wetland is located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-2 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-2. Population Data for the Vicinity of Mackinaw City Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Mackinaw City Wetland is rural open space. The area surrounding the wetland is characterized by residential, commercial, and industrial land uses to the north and east (Mackinaw City), and rural open space to the south and west (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975). The proximity of the wetland to Mackinaw City suggests that the wetland may be subject to moderate to high development pressures should continued expansion of the city take place. Gravel pits, absorption ponds, a transmission corridor, a rail line, and an interstate highway are located in or near Mackinaw City Wetland. Fort Michilimackinac and the Mackinac Straits Bridge lie to the north of the wetland, and ferry docks lie to the east (U.S.G.S. quadrangle map, St. Ignace, Michigan, 1964; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known federal or state recreational facilities in the vicinity of Mackinaw City Wetland.

Mineral, Energy, and Forest Resources

There are four sand and gravel pits operating in close proximity to Mackinaw City Wetland. One pit is situated near the northwestern portion of the wetland, two pits are located just west of the approximate center, and a fourth lies west of the southern portion of the wetland (Michigan Department of State Highways and Transportation aerial photograph, 1973). There are no known oil, gas, or coal resources in or near the wetland (Michigan Geological Survey Division, 1977; Smith, 1915).

Mackinaw City Wetland is partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The literature search did not reveal whether or not this wooded area is used for commercial production.

Public Utilities and Facilities

The Straits Power Plant is located west of Mackinaw City Wetland. The Straits plant is a gas turbine generating plant rated at 20 megawatts, owned by the Consumers Power Company. There are transmission lines from the plant situated west of the wetland (Federal Energy Administration, 1977; U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

Pollution Sources

There are two NPDES permit holders in the vicinity of Mackinaw City Wetland. The Mackinaw City waste water treatment plant is situated south of the wetland (T38N, R3W, SW 1/4 of NE 1/4, Sec. 24). Some of the discharge from this plant is used for irrigation and may enter the groundwater. The Mackinaw Laundry Company, northwest of the wetland (T39N, R4W, Sec. 13), discharges into the groundwater (Michigan Water Quality Division, 1978). The effect (if any) of the discharges by these NPDES permit holders on Mackinaw City Wetland is not known.

An absorption pond is located in Mackinaw City Wetland; the nature and effects of any discharge are not known (Michigan Department of State Highways and Transportation aerial photograph, 1973). No site-specific information was located through the literature search pertaining to non-point sources of pollution in Mackinaw City Wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Mackinaw City Wetland (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that three archaeological sites (20-EM-12, 20-EM-44, 20-EM-48) are present in the vicinity of the wetland. These sites are mounds of an unknown culture and time period (Peebles and Black, 1976). Further information regarding the field research and exact location of the mounds can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 001

The literature search identified no on-going or impending research projects pertaining to Mackinaw City Wetland.

JOHNSON POINT WETLAND

PHYSIOGRAPHIC SETTING

LM 002

Setting

Johnson Point Wetland is located about 400 feet inland from the northeastern shoreline of Lake Michigan in Emmet County, Michigan, two miles west of Mackinaw City. The wetland is situated at the northern end of Trails End Bay, and is a Palustrine System which occupies a raised, wooded site (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Johnson Point Wetland is approximately 5 feet. Wetland elevations range from 593 to 598 feet above sea level (13 to 18 feet above the approximate mean elevation of Lake Michigan). The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Johnson Point Wetland as an erodible low plain. The shoreline features a broad sand beach (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Surficial Geology

The surficial geology of Johnson Point Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Johnson Point Wetland is Wheatley loamy sand, which has a surface layer of black loamy sand underlain by gravelly sand. Wheatley loam sand has low available water capacity and low natural fertility, and may have ponded runoff. It is poorly drained and is generally found in depressions on sand and gravel plains (Alfred et al., 1973).

Hydrology

There are no streams flowing through Johnson Point Wetland, but open water may be present in the wetland during periods of heavy rain (Alfred et al., 1973; U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Johnson Point Wetland is located in Mackinaw City, Michigan. Based on the normal-period from 1931-1960, the mean monthly low for January is 14.6°F and the mean monthly high for July is 66.9°F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28°F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are present within Johnson Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

BIOTIC SETTING

LM 002

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Johnson Point Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Johnson Point Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Johnson Point Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Johnson Point Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Johnson Point Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Johnson Point Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Johnson Point Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 002

Population

Johnson Point Wetland is located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-3 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-3. Population Data for the Vicinity of Johnson Point Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Johnson Point Wetland is rural open space. The area surrounding the wetland is characterized primarily by rural open space, with limited agricultural use. Some residential development exists along the Lake Michigan shoreline, primarily in the vicinity of Trails End Bay (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975). The slightly inland location of the wetland suggests that Johnson Point Wetland may be subject to low developmental pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Johnson Point Wetland.

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Johnson Point Wetland (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). The wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but the literature search did not reveal whether or not this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Johnson Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

Pollution Sources

There are no NPDES permit holders adjacent to Johnson Point Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in this wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Johnson Point Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 002

The literature search identified no on-going or impending research projects pertaining to Johnson Point Wetland.

TRAILS END BAY WETLAND

PHYSIOGRAPHIC SETTING

LM 003

Setting

Trails End Bay Wetland is located about 300 feet inland from the northeastern shoreline of Lake Michigan in Emmet County, Michigan, 2.7 miles southwest of Mackinaw City. It is situated near the southern end of Trails End Bay, and a small pond and a secondary highway are located between the shoreline and the wetland. Trails End Bay Wetland is a Palustrine and intermittent Riverine System which occupies a raised, wooded site (U.S.G.S. quadrangle maps, McGulpin Point, Michigan, 1964 and Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Topography

Elevations of Trails End Bay Wetland range from 595 to 600 feet above sea level (15 to 20 feet above the approximate mean elevation of Lake Michigan). The total relief of the wetland is 5 feet. Trails End Bay Wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Trails End Bay Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Trails End Bay Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Trails End Bay Wetland is Tawas muck, which has a surface layer consisting of black muck underlain by dark gray and dark brown muck and sand. Tawas muck was formed from woody and fibrous organic matter, and contains partially decomposed wood. It is poorly drained and has moderate available water capacity and low natural fertility (Alfred et al., 1973).

Hydrology

An unnamed intermittent stream flows along the northern edge of Trails End Bay Wetland (U.S.G.S. quadrangle maps, McGulpin Point, 1964; Pellston, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, and seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Trails End Bay Wetland is located in Mackinaw City, Michigan. Based on the normal period from

1931-1960, the mean monthly low for January is 14.6⁰F and the mean monthly high for July is 66.9⁰F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28⁰F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are found in the vicinity of Trails End Bay Wetland (U.S.G.S. quadrangle maps, McGulpin Point, Michigan, 1964, and Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 003

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Trails End Bay Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Trails End Bay Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Trails End Bay Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1 but care should be exercised in the interpretation of the relevance of this information to Trails End Bay Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Trails End Bay Wetland, in addition to adjacent open-water and upland segments, was included in a proposed environmental area by the Michigan

Department of Natural Resources (Michigan Shorelands Management Unit, 1975). The area is considered to be a high priority location for waterfowl use. Principal waterfowl utilizing the wetland portion of this area are dabbling and diving ducks, mergansers, coots, geese, and snipe. The area is used primarily for waterfowl staging, feeding, resting, and nesting. Waterfowl use of the area is heavy in comparison to the surrounding habitat.

Shore birds, gulls, and terns also utilize Trails End Bay Wetland, principally for migration stopover, feeding, and resting. Wading birds, including the great blue heron (*Ardea herodias*), American bittern (*Botaurus lentiginosus*), and great egret (*Casmerodius albus*), frequent the wetland. Bald eagles (*Haliaeetus leucocephalus*) and ospreys (*Pandion haliaetus*) have also been observed in the vicinity. The wetland receives light use for wildlife watching (Michigan Shorelands Management Unit, 1975).

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Trails End Bay Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Trails End Bay Wetland.

Endangered Species

Bald eagles, which are on the federal threatened species list, have been observed in the vicinity of Trails End Bay. Osprey, threatened in Michigan, and the rare American bittern are also known to occur in the area (Robert F. Pinal, Wilderness State Park, Carp Lake, personal communication). However, no plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Department of the Interior, Fish and Wildlife Service, 1977; Michigan Department of Natural Resources Endangered and Threatened Species Program, 1976) were documented in Trails End Bay Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Trails End Bay Wetland is very good for waterfowl habitat.

Information is insufficient for evaluation of the wetland as habitat for fish, mammals, or reptiles and amphibians.

Population

Trails End Bay Wetland is located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-4 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-4. Population Data in the Vicinity of Trails End Bay Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Trails End Bay Wetland is rural open space. The area surrounding the wetland is primarily rural open space, with limited residential development along the shoreline of Lake Michigan (Michigan Department of State Highways and Transportation aerial photograph, 1973). The western portion of the wetland is under state ownership, while the remainder of the wetland is privately owned (Rockford Map Publishers, Inc., 1975).

The portion of the wetland which is state owned is likely to be subject to low development pressures. The location of wetland near the shoreline, coupled with the presence of limited residential development, suggests that the privately owned portion of Trails End Bay Wetland may be subject to moderate development pressure. A secondary highway is located between Trails End Bay Wetland and the shoreline (U.S.G.S. quadrangle maps, McGulpin Point, Michigan, 1964, and Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

Trails End Bay Wetland lies within the Hardwood State Forest, and portions of the wetland are state owned. Although there are no known areas specifically designated for recreational use in or near the wetland, all Michigan state

forest lands are open for camping unless otherwise posted. Hunting and fishing also constitute major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Trails End Bay Wetland (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). The wetland lies within the Hardwood State Forest (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). State forest lands in the coastal area are within a "water influence zone," where water quality, water use, and aesthetic surroundings are the principal management concerns. Cover treatments are designed to maintain or enhance these factors, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Trails End Bay Wetland (U.S.G.S. quadrangle maps, Pellston, Michigan, 1958; McGulpin Point, Michigan, 1964).

Pollution Sources

There are no NPDES permit holders adjacent to Trails End Bay Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in this wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Trails End Bay Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 003

The literature search identified no on-going or impending research projects pertaining to Trails End Bay Wetland.

WA-WATAM POINT WETLAND

PHYSIOGRAPHIC SETTING

LM 004

Setting

Wa-Watam Point Wetland is adjacent to the northeastern shoreline of Lake Michigan in Emmet County, Michigan, 4.3 miles southwest of Mackinaw City, on a headland which separates Cecil Bay and Trails End Bay. A small system of coastal beach ridges parallels the shoreline near this headland, and marshes lie within the swales. Wa-Watam Point Wetland is a Lacustrine System, and occupies a low, wooded site within the Hardwood State Forest (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The relief of Wa-Watam Point Wetland is very slight; wetland elevations range from 580 to 582 feet above sea level (lake level to 2 feet above the approximate mean elevation of Lake Michigan). The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Wa-Watam Point Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Wa-Watam Point Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Wa-Watam Point Wetland is Roscommon mucky sand, which has a surface layer of very dark brown mucky sand and a substratum of light yellowish-brown sand. Roscommon mucky sand has low available water capacity, low natural fertility, and rapid permeability. This soil was formed from sand and is poorly drained (Alfred et al., 1973).

Hydrology

There are no streams flowing through Wa-Watam Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Wa-Watam Point Wetland is located in Mackinaw City, Michigan. Based on the normal period from 1931-1960, the mean monthly low for January is 14.6^oF and the mean monthly high for July is 66.9^oF. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28^oF) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are found in the vicinity of Wa-Watam Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

BIOTIC SETTING

LM 004

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Wa-Watam Point Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Wa-Watam Point Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels for the invertebrates present in Wa-Watam Point Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Wa-Watam Point Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Wa-Watam Point Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Wa-Watam Point Wetland.

Endangered Species

The bald eagle (Haliaeetus leucocephalus), which is on the federal list of threatened species list, has been observed in the vicinity of Wa-Watam Point Wetland. The osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus), are also known to occur in the area (Robert F. Pinal, Wilderness State Park, Carp Lake, personal communication). However, no other plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Department of Natural Resources Endangered and Threatened Species Program, 1976) were documented in Wa-Watam Point Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 004

Population

Wa-Watam Point Wetland is located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-5 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-5. Population Data for the Vicinity of Wa-Watam Point Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Wa-Watam Point Wetland is rural open space. The area surrounding the wetland is also rural open space, with limited residential development along the Lake Michigan shoreline (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is within the privately-owned Mackinaw Shores residential development (Rockford Map Publishers, Inc., 1975), which suggests that it is subject to moderate to high developmental pressures. An access road lies inland of Wa-Watam Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

Recreation

Although Wa-Watam Point Wetland lies within the Hardwood State Forest, it is privately owned. Thus, any recreational use of the wetland would depend upon the owner's permission (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal resources in close proximity to Wa-Watam Point Wetland (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). State forest lands in the coastal area are within a "water influence zone," where water quality, water use, and aesthetic surroundings are the principal management concerns. Cover treatments are designed to maintain or enhance these factors, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Wa-Watam Point Wetland (U.S.G.S. quadrangle map, McGulpin Point, Michigan, 1964).

Pollution Sources

There are no NPDES permit holders adjacent to Wa-Watam Point Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Wa-Watam Point Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 004

The literature search identified no on-going or impending research projects pertaining to Wa-Watam Point Wetland.

CARP LAKE RIVER AREA WETLAND

PHYSIOGRAPHIC SETTING

LM 005

Setting

Carp Lake River Area Wetland is located near the northeastern shore of Lake Michigan in Emmet County, Michigan. The wetland lies to the west of Carp Lake River, 0.1 mile inland from Cecil Bay and 4.0 miles northwest of the community of Carp Lake. Low coastal beach ridges parallel the shoreline of Cecil Bay; the wetland lies behind these ridges. Carp Lake River Area Wetland is a low, wooded Palustrine System situated within the Hardwood State Forest (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Carp Lake River Area Wetland is approximately 10 feet. Wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Carp Lake River Area Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Carp Lake River Area Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Carp Lake River Area Wetland is Roscommon-Eastport sand. Roscommon soils are generally found on old lake beach areas and in swales, while Eastport soils are generally found on ridges. Roscommon soil consists of very dark brown mucky sand underlain with mottled yellowish-brown sand. It is poorly drained and has low natural fertility and low available water capacity (Alfred et al., 1973).

Hydrology

There are no streams flowing through Carp Lake River Area Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for the Carp Lake River Area Wetland is located in Mackinaw City, Michigan. Based on the normal period

from 1931-1960, the mean monthly low for January is 14.6⁰F and the mean monthly high for July is 66.9⁰F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28⁰F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are present in Carp Lake River Area Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 005

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Carp Lake River Area Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Carp Lake River Area Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Carp Lake River Area Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Carp Lake River Area Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Carp Lake River Area Wetland. The

literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Carp Lake River Area Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Carp Lake River Area Wetland by the literature search. However, the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) have been known to occur in the Cecil Bay-Trails End Bay area (Robert F. Pital, Wilderness State Park, Carp Lake, Michigan, personal communication).

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 005

Population

Carp Lake River Area Wetland is located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-6 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-6. Population Data for the Vicinity of Carp Lake River Area Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Carp Lake River Area Wetland is rural open space. The area surrounding the wetland is characterized primarily by rural open space, with limited residential development along the shoreline of Cecil Bay (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under private ownership (Rockford Map Publishers, Inc., 1973), but its inland location, as well as the presence of only limited residential development in the vicinity, suggests that development pressures on Carp Lake River Area Wetland will be low.

Recreation

Although Carp Lake River Area Wetland lies within the Hardwood State Forest, it is privately owned. Therefore, recreational use of this wetland would depend upon the owner's permission.

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Carp Lake River Area Wetland (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). Carp Lake River Area Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this area is used for commercial production. Any timber harvesting within this area may be subject to state forest policy.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Carp Lake River Area Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Carp Lake Area Wetland (Michigan Water Quality Division, 1978). No site-specific information was

located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No know historical sites exist within 500 feet of Carp Lake Area Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 005

The literature search identified no on-going or impending research projects pertaining to Carp Lake Area Wetland.

CECIL BAY WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 006-007

Setting

The Cecil Bay Wetland Complex, comprised of Cecil Bay Wetlands #1 and #2, lies on the northeastern shore of Lake Michigan along Cecil Bay in Emmet County, Michigan. Cecil Bay Wetland #1 is adjacent to the lakeshore, 4.7 miles northwest of the community of Carp Lake. This wetland is a Lacustrine System featuring emergent vegetation growing in the shallow water of Cecil Bay. The wetland occupies a low, partially wooded site lakeward of low coastal beach ridges. Cecil Bay Wetland #2 lies 250 feet inland from the shoreline and 5.0 miles northwest of Carp Lake. This wetland is a wooded Palustrine System and occupies a raised site within Wilderness State Park (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Topography

Cecil Bay Wetland #1 has a total relief of less than 10 feet; wetland elevations range from 580 to approximately 590 feet above sea level (lake level to 20 feet above the approximate mean elevation of Lake Michigan). Cecil Bay Wetland #2 has a total relief of 15 feet, with elevations ranging from 600 to 615 feet above sea level.

Cecil Bay Wetlands #1 and #2 lie on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near the Cecil Bay Wetland Complex as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Cecil Bay Wetlands #1 and #2 is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Cecil Bay Wetland #1 is Eastport sand; in Cecil Bay Wetland #2 it is Thomas mucky loam. Eastport sand has been altered by shifting wind, which has prevented the formation of a distinct soil profile. This soil ranges from dark grayish-brown to very pale brown sand with low available water capacity and low natural fertility. It is a well drained soil and is generally found on beach ridges and low dunes. Thomas mucky loam has a surface layer of very dark gray mucky loam with high available water capacity and medium natural fertility. It is a poorly drained soil which formed from silty clay loam and is generally found on glacial lake plains (Alfred et al., 1973).

Hydrology

There are no streams flowing through Cecil Bay Wetlands #1 and #2 (U.S.G.S. quadrangle map, Pellston, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Cecil Bay Wetlands #1 and #2.

Climate

The closest weather station providing climatic data for Cecil Bay Wetlands #1 and #2 is located in Mackinaw City, Michigan. Based on the normal period from 1931-1960, the mean monthly low for January is 14.6°F and the mean monthly high for July is 66.9°F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28°F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are found in the vicinity of the Cecil Bay Wetland Complex (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 006-007

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Cecil Bay Wetlands #1 and #2.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Cecil Bay Wetlands #1 and #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Cecil Bay Wetlands #1 and #2.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Cecil Bay Wetlands #1 and #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Recent observations in the Cecil Bay area suggest that waterfowl are prevalent in the area and that various species of ducks nest there (Robert R. Pinal, Wilderness State Park, Carp Lake, Michigan, personal communication). Wading birds, including the great blue heron (Ardea herodias), great egret (Casmerodius albus), and the American bittern (Botaurus lentiginosus), are present. Bald eagles (Haliaeetus leucocephalus) and ospreys (Pandion haliaetus) are also seen in the Cecil Bay Area.

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Cecil Bay Wetlands #1 and #2. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these wetlands.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) may be found on Cecil Bay Wetland #2 (Michigan Department of Natural Resources, undated).

The literature search provided no other site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, life histories, food sources, or relationship to water levels of the mammals inhabiting the Cecil Bay Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented specifically in the Cecil Bay Wetland Complex by the literature search. However, the bald eagle (Haliaeetus leucocephalus), on the Federal list; the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) are known to occur in the Cecil Bay area (Robert F. Pinal, Wilderness State Park, Carp Lake, Michigan, personal communication).

Health

Site-specific information indicates that the environmental quality of Cecil Bay Wetlands #1 and #2 is very good. Minimal developmental pressure occurs in the area, and large mammals and some endangered bird species are found here.

CULTURAL SETTING

LM 006-007

Population

Cecil Bay Wetlands #1 and #2 are located in Wa-Watam Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-7 indicates that Emmet County experienced a rapid rate of population growth between 1970 and 1975, but Wa-Watam Township experienced a rapid decline in population during the same time period. Projections for 1990 indicate that rapid population growth is expected to continue in Emmet County.

Table 1-7. Population Data for the Vicinity of Cecil Bay Wetlands #1 and #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Wa-Watam Township	406	-5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Cecil Bay Wetlands #1 and #2 is rural open space. The area surrounding the wetlands is primarily rural open space, with limited residential development along the shoreline of Lake Michigan (Michigan Department of State Highways and Transportation aerial photograph, 1973). Cecil Bay Wetland #1 is under private ownership; Cecil Bay Wetland #2 is under state ownership (Rockford Map Publishers, Inc., 1975).

Since Cecil Bay Wetland #2 lies within Wilderness State Park, development pressures can be considered minimal. The park has been nominated as an environmental "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be accepted, Cecil Bay Wetland #2 will probably be assured of protection from development. Cecil Bay Wetland #1 lies

outside of the park boundaries, but owing to the apparent absence of immediate residential, agricultural, and commercial pressures, development pressures on Cecil Bay Wetland #1 are likely to be low. An access road lies landward of Cecil Bay Wetland #1 and lakeward of Cecil Bay Wetland #2 (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

Recreational activities in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. The area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting (Michigan Shorelands Management Unit, 1975). The park is considered to be an excellent site for geological and nature study (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Cecil Bay Wetlands #1 and #2 (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). Cecil Bay Wetland #2 is wooded (Michigan Department of State Highways and Transportation aerial photograph, 1973). However, timber stands in Michigan's state parks are managed principally for aesthetic and recreational purposes, so commercial timber harvests there are prohibited in most cases (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Cecil Bay Wetlands #1 and #2 (U.S.G.S. quadrangle map, Pellston, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Cecil Bay Wetlands #1 and #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in these wetlands.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Cecil Bay Wetlands #1 and #2 (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that one archaeological site (20-EM-19, from the Late Woodland period) is present in the vicinity of the wetlands (Peebles and Black, 1976). Further information regarding the field research and exact location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 006-007

The literature search identified no on-going or impending research projects pertaining to Cecil Bay Wetlands #1 and #2.

BIG STONE POND WETLAND

PHYSIOGRAPHIC SETTING

LM 008

Setting

Big Stone Pond Wetland is located near the northeastern shoreline of Lake Michigan in Emmet County, Michigan. The wetland lies 0.2 mile inland from Big Stone Bay and 5.6 miles northwest of the community of Carp Lake. Big Stone Pond adjoins the wetland to the north, and spruce-tamarack bogs are contiguous with the wetland to the east and west. Big Stone Pond Wetland is a perennial Riverine and Palustrine System; it occupies a raised, partially-wooded site within Wilderness State Park (U.S.G.S. quadrangle map, Pellston, Michigan, 1958).

Topography

The total relief of Big Stone Pond Wetland is 20 feet; wetland elevations range from 590 to 610 feet above sea level, 10 to 30 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Big Stone Pond Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Big Stone Pond Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Big Stone Pond Wetland is Carbondale muck, which has a surface layer of black muck underlain by brown mucky peat. Carbondale muck is formed from decomposed woody materials and is very poorly drained; it has high available water capacity but low natural fertility (Alfred et al., 1973).

Hydrology

Big Stone Creek flows north through Big Stone Pond Wetland. The creek originates just south of the wetland and runs along the eastern border before flowing into an unnamed lake. Big Stone Creek has an elevational change of approximately 15 feet as it travels through the wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958). Big Stone Pond is the largest of the three shallow open-water areas in the wetland, and was artificially created by damming Big Stone Creek. Information on the flow rates of Big Stone Creek are not available. However, the flow of the creek has been slowed by numerous beaver dams (Pettingill et al., 1957).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Big Stone Pond Wetland.

Climate

The closest weather station providing climatic data for Big Stone Pond Wetland is located in Mackinaw City, Michigan. Based on the normal period from 1931-1960, the mean monthly low for January is 14.6°F and the mean monthly high for July is 66.9°F. The average annual precipitation is 28.88 inches, with a mean monthly precipitation of 1.59 inches in January and 2.37 inches in July. The first killing frost (28°F) in 1972 occurred on October 10. Average annual temperature and freeze data are not readily available (National Oceanic and Atmospheric Administration, 1972).

Special Features

No natural special features are found in the vicinity of Big Stone Pond Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photography 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 008

Vegetation

Big Stone Pond Wetland has been described by Pettingill et al. (1957) as a bullrush marsh featuring many high shrubs, remnants of woods that preceded formation of the wetland. The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Big Stone Pond Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Big Stone Pond Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Big Stone Pond Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Big Stone Pond Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Pettingill et al. (1957), Big Stone Pond Wetland is the most noteworthy of the wetlands within Wilderness State Park. Table 1-8 lists the bird species which are known to occur in Big Stone Pond Wetland or Big Stone Pond. The list is incomplete since it refers primarily to summer species.

Table 1-8. Birds Occurring in Big Stone Pond or Big Stone Pond Wetland^a

<u>Species</u>	<u>Status</u>
pied-billed grebe	
great blue heron	summer resident
black-crowned night heron	
black duck	common summer resident
pintail	rare
green-winged teal	rare
blue-winged teal	rare
wood duck	
sharp-shinned hawk	
bald eagle	
marsh hawk	summer resident
common snipe	summer resident
spotted sandpiper	common summer resident
solitary sandpiper	transient
greater yellowlegs	transient
lesser yellowlegs	transient
willow flycatcher	common summer resident
tree swallow	summer resident
black-throated blue warbler	uncommon summer resident

^a Pettingill et al. (1957)

Pettingill et al. also list the American bittern (Botaurus lentiginosus), Virginia rail (Rallus limicola), short-billed marsh wren (Cistothorus platensis), red-winged blackbird (Agelaius phoeniceus), and swamp sparrow (Melospiza georgiana) as birds known to breed regularly in the Wilderness State Park wetlands. Species presumed to breed regularly in the Park include the

marsh hawk (Circus cyaneus), sora (Porzana carolina), and common snipe (Capella gallinago).

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Big Stone Pond Wetland.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Big Stone Pond Wetland.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) can be found on Big Stone Pond Wetland (Michigan Department of Natural Resources, undated). Hunting is not permitted.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Big Stone Pond Wetland by the literature search. However, recent observations (Robert F. Pinal, Wilderness State Park, Carp Lake, Michigan, personal communication) note that the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) are seen in the wetlands of Wilderness State Park. Pettingill et al. (1957) noted that, although there were no eagles nesting in the park, an aerie that had been used previously was located in a tree south of Big Stone Pond. Pettingill et al. also list the marsh hawk, the black-crowned night heron (Nycticorax nycticorax), and the sharp-shinned hawk (Accipiter striatus) all threatened or rare in Michigan, as occurring in the vicinity of Big Stone Pond Wetland. The marsh hawk and American bittern apparently breed in the Wilderness State Park area.

Health

Site-specific information indicates that the environmental quality of Big Stone Pond Wetland is very good for birds and mammals.

Information is insufficient for evaluation of the wetland as habitat for fish or reptiles and amphibians.

Population

Big Stone Pond Wetland is located in Bliss Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-9 indicates that Emmet County and Bliss Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Emmet County is expected to undergo continued rapid population growth.

Table 1-9. Population Data for the Vicinity of Big Stone Pond Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Bliss Township	398	41.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Big Stone Pond Wetland and most of the surrounding area is rural open space. A camping area lies between the wetland and Big Stone Bay (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under state ownership (Rockford Map Publishers, Inc., 1975), so developmental pressures should be minimal. Wilderness State Park has been nominated as an environmental "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, Big Stone Pond Wetland will probably be assured of protection from development. Foot trails and camping facilities are located near Big Stone Pond Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photography 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

Recreational activities available in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. The area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting. Wilderness State Park is an excellent site for geological and nature study (Michigan Shorelands Management Unit, 1975).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Big Stone Pond Wetland (Gere, 1977; Michigan Geological Survey 1977; Smith, 1915). Big Stone Pond Wetland is partially wooded, but timber stands in Michigan's state parks are managed principally for aesthetic and recreational purposes and commercial timber harvests are prohibited in most instances (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Big Stone Pond Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Big Stone Pond Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in this wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Big Stone Pond Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 008

The literature search identified no on-going or impending research projects pertaining to Big Stone Pond Wetland.

WAUGOSHANCE POINT WETLAND #1

PHYSIOGRAPHIC SETTING

LM 009

Setting

Waugoshance Point Wetland #1 is located 0.2 mile from the northeastern shoreline of Lake Michigan in Emmet County, Michigan, ten miles west of Mackinaw City. A line of low dunes and a sand and gravel beach lie between the wetland and the lakeshore. Waugoshance Point Wetland #1 is a wooded Palustrine System and occupies a raised site within Wilderness State Park (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964).

Topography

The total relief of Waugoshance Point Wetland #1 is less than 10 feet; wetland elevations range from approximately 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Waugoshance Point Wetland #1 as an erodible low plain.

Surficial Geology

The surficial geology of Waugoshance Point Wetland #1 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Waugoshance Point Wetland #1 is Roscommon-Eastport sand. Roscommon soils are found on old lake beach areas and in swales, while Eastport sand is found on ridges. Roscommon soil consists of very dark brown, mucky sand underlain with mottled yellowish-brown sand. It is poorly drained and has low natural fertility and low available water capacity. Eastport sand also has low available water capacity and low natural fertility (Alfred et al., 1973).

Hydrology

There are no streams flowing through Waugoshance Point Wetland #1 (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Waugoshance Point Wetland #1.

Climate

The closest weather station providing climatic data for Waugoshance Point Wetland #1 is located in Cross Village, Michigan. In 1975, the average monthly temperature was 45.2°F; the average daily low for January was 17.6°F and the average daily high in July was 78.4°F. The average annual precipitation is 29.43 inches, with a mean monthly precipitation of 2.22 inches in January and 2.59 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on April 26 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Waugoshance Point Wetland #1 (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 009

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Waugoshance Point Wetland #1.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Waugoshance Point Wetland #1.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Waugoshance Point Wetland #1.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1 but care should be exercised in the interpretation of the relevance of this information to Waugoshance Point Wetland #1. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contains general information on the wetland birds of Lake Section 1 but care should be exercised in the interpretation of the relevance of this information to Waugoshance Point Wetland #1. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) can be found on Waugoshance Point Wetland #1 (Michigan Department of Natural Resources, undated).

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Waugoshance Point Wetland #1 by the literature search. However, according to Robert F. Pinal (Wilderness State Park, Carp Lake, Michigan, personal communication), the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) have recently been observed in wetlands located within Wilderness State Park.

Health

Site-specific information indicates that the environmental quality of Waugoshance Point Wetland #1 is very good. Minimal developmental pressure occurs in the area, and large mammals and some endangered bird species are found here.

CULTURAL SETTING

LM 009

Population

Waugoshance Point Wetland #1 is located in Bliss Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-10 indicates that Emmet County and Bliss Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Emmet County is expected to undergo continued rapid population growth.

Table 1-10. Population Data for the Vicinity of Waugoshance Point Wetland #1

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Bliss Township	398	41.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Waugoshance Point Wetland #1 and in the surrounding area is rural open space (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under state ownership (Rockford Map Publishers, Inc., 1975).

The location of Waugoshance Point Wetland #1 within Wilderness State Park suggests that it is subject to minimal developmental pressure. Wilderness State Park has been nominated as an environmental "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the wetland will probably be assured protection from development.

Recreation

Recreational activities available in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. The area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting (Michigan Shorelands Management Unit, 1975).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal deposits in close proximity to Waugoshance Point Wetland #1 (Gere, 1977; Michigan Geological Survey 1977; Smith, 1915). Waugoshance Point Wetland is wooded, but timber stands in Michigan's state parks are managed principally for aesthetic and recreational purposes, and commercial timber harvests are prohibited in most instances (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Waugoshance Point Wetland #1 (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964).

Pollution Sources

There are no NPDES permit holders adjacent to Waugoshance Point Wetland #1 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in this wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Waugoshance Point Wetland #1, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 009

The literature search identified no on-going or impending research projects pertaining to Waugoshance Point Wetland #1.

WAUGOSHANCE POINT WETLAND #2

PHYSIOGRAPHIC SETTING

LM 010

Setting

Waugoshance Point Wetland #2 is located adjacent to the northeastern shoreline of Lake Michigan in Emmet County, Michigan, 12.5 miles west of Mackinaw City and within Wilderness State Park. Waugoshance Point Wetland #2 is a partially wooded Lacustrine System situated in a low area of sand and gravel beach and dunes. A lagoon lies to the north of the wetland (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964).

Topography

Waugoshance Point Wetland #2 has slight relief; elevations in the wetland range from 580 to 583 feet above sea level (lake level to 3 feet above the approximate mean elevation of Lake Michigan). The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Waugoshance Point Wetland #2 as an erodible low plain.

Surficial Geology

The surficial geology of Waugoshance Point Wetland #2 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Waugoshance Point Wetland #2 is Stoney lake beach, a miscellaneous land type consisting of loose sand, gravel, and stone. These soil materials have not weathered sufficiently to have formed a distinct soil profile (Alfred et al., 1973).

Hydrology

There are no streams flowing through Waugoshance Point Wetland #2 (U.S.G.S. quadrangle map, Big Stone Bay, Michigan 1964). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Waugoshance Point Wetland #2.

Climate

The closest weather station providing climatic data for Waugoshance Point Wetland #2 is located in Cross Village, Michigan. In 1975, the average monthly temperature was 45.2°F; the average daily low for January was 17.6°F and the

average daily high in July was 78.4°F. The average annual precipitation is 29.43 inches, with a mean monthly precipitation of 2.22 inches in January and 2.59 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on April 26 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Temperance Island lies to the west of Waugoshance Point Wetland #2 (U.S.G.S. quadrangle map, Big Stone Bay, Michigan, 1964; Michigan Department of State Highways and Transportation aerial reconnaissance, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 010

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Waugoshance Point Wetland #2.

Fish

The Lake Michigan waters adjacent to Waugoshance Point support a relatively dense population of smallmouth bass (Micropterus dolomieu), and "wading for bass" along the shore of the point is popular among anglers. According to a study reported by Latta (1963), adult smallmouth bass began spawning in June in sheltered, shallow bays along Waugoshance Point, primarily along the southern shore. Nests were mainly constructed on bottoms of gravel and rubble, but a few were placed in sand among the rootlets of aquatic plants. Emergent vegetation adjacent to nests also served as cover for fry. Other species associated with smallmouth bass at Waugoshance Point included northern pike (Esox lucius), carp (Cyprinus carpio), common shiner (Notropis cornutus), white sucker (Catostomus commersoni), brown bullhead (Ictalurus nebulosus), rock bass (Ambloplites rupestris), and yellow perch (Perca flavescens).

Waugoshance Point Wetland #2 may be utilized by smallmouth bass and the other seven species as a feeding, spawning, and nursery area. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Waugoshance Point Wetland #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Waugoshance Point Wetland #2.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Waugoshance Point Wetland #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Pettingill et al. (1957) compiled a list of birds observed at Waugoshance Point. This list, presented in Table 1-11, may be indicative of species present in Waugoshance Point Wetland #2.

Table 1-11. Birds Recorded at Waugoshance Point^a

<u>Species</u>	<u>Status</u>
great blue heron	summer resident
American bittern	summer resident
green-winged teal	rare
blue-winged teal	common summer resident
scaup spp.	rare transient
osprey	
sora	summer resident
greater yellowlegs	transient
lesser yellowlegs	transient
red knot	rare transient
pectoral sandpiper	transient
white-rumped sandpiper	rare transient
Baird's sandpiper	common transient
dunlin	rare transient
semipalmated sandpiper	transient
sanderling	transient
dowitcher	rare transient

^a Pettingill et al. (1957)

Appendices D-1, D-2, and D-3 present general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Waugoshance Point Wetland #2. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) can be found on Waugoshance Point Wetland #2 (Michigan Department of Natural Resources, undated).

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Waugoshance Point Wetland #2 by the literature search. However, according to Robert F. Pintal, (Wilderness State Park, Carp Lake, Michigan, personal communication) the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) have recently been observed in the wetlands located within Wilderness State Park.

Health

Site-specific information indicates that the environmental quality of Waugoshance Point Wetland #2 is very good. Minimal developmental pressure occurs in the area, and large mammals and some endangered bird species are found here.

CULTURAL SETTING

LM 010

Population

Waugoshance Point Wetland #2 is located in Bliss Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 1-12 indicates that Emmet County and Bliss Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Emmet County is expected to undergo continued rapid population growth.

Table 1-12. Population Data for the Vicinity of Waugoshance Point Wetland #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Bliss Township	398	41.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Waugoshance Point Wetland #2 and in the surrounding area is rural open space (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under state ownership (Rockford Map Publishers, Inc., 1975).

The location of Waugoshance Point Wetland #2 within Wilderness State Park suggests that it is subject to minimal developmental pressure. Wilderness State Park has been nominated as an environmental "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the wetland will probably be assured protection from development.

Recreation

Recreational activities available in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. The area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting (Michigan Shorelands Management Unit, 1975).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal resources in close proximity to Waugoshance Point Wetland #2 (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). There are no significant forest resources in the wetland (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Waugoshance Point Wetland #2 (U.S.G.S. quadrangle maps, Cross Village, Michigan, 1958; Big Stone Bay, Michigan, 1964).

Pollution Sources

There are no NPDES permit holders adjacent to Waugoshance Point Wetland #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution in this wetland.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Waugoshance Point Wetland #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 010

The literature search identified no on-going or impending research projects pertaining to Waugoshance Point Wetland #2.

WAUGOSHANCE ISLAND WETLAND

PHYSIOGRAPHIC SETTING

LM 011

Setting

Waugoshance Island Wetland is located adjacent to the shoreline on Waugoshance Island, which lies offshore from the northeastern shore of Lake Michigan in Emmet County, Michigan, 15 miles west of Mackinaw City. Waugoshance Island Wetland is a Lacustrine System and occupies a low, heavily wooded site within Wilderness State Park (U.S.G.S. quadrangle map, Cross Village, Michigan, 1958).

Topography

The total relief of Waugoshance Island Wetland is 5 feet; wetland elevations range from 580 to 585 feet above sea level (lake level to 5 feet above the approximate mean elevation of Lake Michigan). The island lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. The Great Lakes Basin Commission (1975) describes the shoreline near Waugoshance Island Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Waugoshance Island Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin 1957; Dorr and Eschman, 1970).

Soils

The soil type for Waugoshance Island Wetland is Stoney lake beach, a miscellaneous land type consisting of loose sand, gravel, and stone. These soil materials have not weathered sufficiently to have formed a distinct soil profile (Alfred et al., 1973).

Hydrology

There are no streams flowing through Waugoshance Island Wetland (U.S.G.S. quadrangle map, Cross Village, Michigan, 1971). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Waugoshance Island Wetland.

Climate

The closest weather station providing climatic data for Waugoshance Island Wetland is located in Cross Village, Michigan. In 1975, the average monthly temperature was 45.2⁰F; the average daily low for January was 17.6⁰F and the average daily high in July was 78.4⁰F. The average annual precipitation is 29.43 inches, with a mean monthly precipitation of 2.22 inches in January and

2.59 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on April 26 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

A small lake is located to the north of the wetland on Waugoshance Island, and several sand spits extend into Lake Michigan in a northwestward direction from the island (U.S.G.S. quadrangle map, Cross Village, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973).

BIOTIC SETTING

LM 011

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Waugoshance Island Wetland.

Fish

The smallmouth bass (Micropterus dolomieu) and associated fish species at Waugoshance Point are discussed in connection with Waugoshance Point Wetland #2 (LM 010). Observations by Latta (1963) indicate that these species may utilize the wetlands along Waugoshance Point, including Waugoshance Point Island Wetland, as feeding, nesting, and nursery areas. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Waugoshance Island Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Waugoshance Island Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Waugoshance Island Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Waugoshance Island Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) can be found on Waugoshance Island Wetland (Michigan Department of Natural Resources, undated).

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented specifically in Waugoshance Island Wetland by the literature search. However, according to Robert F. Pinal (Wilderness State Park, Carp Lake, Michigan, personal communication), the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) have been observed in wetlands located within Wilderness State Park.

Health

Site-specific information indicates that the environmental quality of Waugoshance Island Wetland is very good. Minimal developmental pressure occurs in the area, and large mammals and some endangered bird species are found here.

CULTURAL SETTING

LM 011

Population

Waugoshance Island Wetland is located on Waugoshance Island, which is apparently uninhabited although some seasonal population may be present.

Land Use and Ownership

Land use within Waugoshance Island Wetland and in the surrounding area is rural open space (Michigan Department of State Highways and Transportation aerial photograph, 1973). Waugoshance Island is under state ownership (Rockford Map Publishers, Inc., 1975). Given the fact that the island is uninhabited and is state owned, developmental pressures on Waugoshance Island Wetland are assumed to be minimal.

Recreation

Recreational activities in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. This area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting (Michigan Shorelands Management Unit, 1975). Wilderness State Park is an excellent site for geological and nature study (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal resources in close proximity to Waugoshance Island Wetland (Gere, 1977; Michigan Geological Survey Division, 1977; Smith, 1915). Waugoshance Island Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but its location on a relatively small island within a state park suggests that commercial use of this wooded area is unlikely.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Waugoshance Island Wetland (U.S.G.S. quadrangle map, Cross Village, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Waugoshance Island Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Waugoshance Island Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 011

The literature search identified no on-going or impending research projects pertaining to Waugoshance Island Wetland.

LITTLE SUCKER CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 012

Setting

Little Sucker Creek Wetland is located near the northeastern shoreline of Lake Michigan on Sturgeon Bay in Emmet County, Michigan. Coastal beach ridges parallel the shoreline of Sturgeon Bay, and Little Sucker Creek Wetland lies behind and north of these ridges. It is a Riverine and Palustrine System and occupies a raised, partially wooded site within Wilderness State Park (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1978; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Little Sucker Creek Wetland is 10 feet; wetland elevations range from 585 to 595 feet above sea level (5 to 15 feet above the approximate mean elevation of Lake Michigan). The wetland lies on a low lacustrine plain on the south-facing slope of the Niagara Cuesta. Large wetlands occupy low inland sites on this plain. The Great Lakes Basin Commission (1975) describes the shoreline near Little Sucker Creek Wetland as sand dunes featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Little Sucker Creek Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Little Sucker Creek Wetland is Linwood muck, which has a surface layer of black muck underlain by mildly alkaline brown loam. This soil has high available water capacity and low natural fertility, and may have ponded runoff. Linwood muck is a very poorly drained soil that formed from well decomposed organic material (Alfred et al., 1973).

Hydrology

Little Sucker Creek flows north through Little Sucker Creek Wetland for approximately one mile before turning south to Sturgeon Bay. Little Sucker Creek has two forks which originate in the wetland and have little change in elevation. A small pond lies within the wetland. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Little Sucker Creek Wetland.

Climate

The closest weather station providing climatic data for Little Sucker Creek Wetland is located in Cross Village, Michigan. In 1975, the average monthly temperature was 45.2°F; the average daily low for January was 17.6°F and the average daily high in July was 78.4°F. The average annual precipitation is 29.43 inches, with a mean monthly precipitation of 2.22 inches in January and 2.59 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on April 26 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present within Little Sucker Creek Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 012

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Little Sucker Creek Wetland.

Fish

The smallmouth bass (*Micropterus dolomieu*) and associated fish species at Waugoshance Point are discussed in connection with Waugoshance Point Wetland #2 (LM 010). Observations by Latta (1963) indicate that these species may utilize wetlands along Waugoshance Point, including Little Sucker Creek Wetland, as feeding, spawning, and nursery areas. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Little Sucker Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Little Sucker Creek Wetland.

Reptiles and Amphibians

Appendix C-1 contains general information on the reptiles and amphibians of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Little Sucker Creek Wetland. The literature

search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-1, D-2, and D-3 contain general information on the wetland birds of Lake Section 1, but care should be exercised in the interpretation of the relevance of this information to Little Sucker Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Snowshoe hare (Lepus americanus), beaver (Castor canadensis), river otter (Lutra canadensis), and white-tailed deer (Odocoileus virginianus) can be found on Little Sucker Creek Wetland (Michigan Department of Natural Resources, undated).

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented specifically in Little Sucker Creek Wetland by the literature search. However, according to Robert F. Pinal (Wilderness State Park, Carp Lake, Michigan, personal communication), the federally listed bald eagle (Haliaeetus leucocephalus), the osprey (Pandion haliaetus), threatened in Michigan, and the rare American bittern (Botaurus lentiginosus) have been observed in wetlands within Wilderness State Park.

Health

Site-specific information indicates that the environmental quality of Little Sucker Creek Wetland is very good. Minimal developmental pressure occurs in the area, and large mammals and some endangered bird species are found here.

CULTURAL SETTING

LM 012

Population

Little Sucker Creek Wetland is located in Bliss Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per

square mile. Table 1-13 indicates that Emmet County and Bliss Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Emmet County is expected to undergo continued rapid population growth.

Table 1-13. Population Data for the Vicinity of Little Sucker Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
Bliss Township	398	41.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Little Sucker Creek Wetland and in most of the surrounding area is rural open space (Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under state ownership (Rockford Map Publishers, Inc., 1975).

The location of Little Sucker Creek Wetland within Wilderness State Park suggests that it is subject to minimal developmental pressure. Wilderness State Park has been nominated as an environmental "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the wetland will probably be assured protection from development.

Recreation

Recreational activities available in Wilderness State Park include hunting, fishing, camping, swimming, and picnicking. A boat launch is also available. This area receives heavy use for wildlife watching, moderate use for fishing, and light use for boating and hunting (Michigan Shorelands Management Unit, 1975). Wilderness State Park is an excellent site for geological and nature study (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

There are no mineral, oil, gas, or coal resources in close proximity to Little Sucker Creek Wetland (Gere, 1977; Michigan Geological Survey 1977; Smith, 1915). Little Sucker Creek Wetland is partially wooded, but timber stands in Michigan's state parks are managed principally for aesthetic and recreational purposes and commercial timber harvests are prohibited in most

instances (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Little Sucker Creek Wetland (U.S.G.S. quadrangle map, Pellston, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Little Sucker Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Little Sucker Creek Wetland (Peebles and Black, 1976). The Michigan Coastal Zone Inventory indicates that one archaeological site (EM-A, an historical Indian settlement) is present in the vicinity of Little Sucker Creek Wetland (Peebles and Black, 1976). Further information regarding the field research and exact location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 012

The literature search identified no on-going or impending research projects pertaining to Little Sucker Creek Wetland.

Table 1-14. Data Gaps - Lake Section 1

Data Gap*		Wetland Number	001	002	003	004	005	006-007	008	009	010	011	012	
Physiographic Setting	Setting													
	Topography													
	Surficial Geology													
	Soils													
	Hydrology	Water Level Fluctuations	*	*	*	*	*	*	*	*	*	*	*	*
		Groundwater	*	*	*	*	*	*	*	*	*	*	*	*
		Water Quality	*	*	*	*	*	*	*	*	*	*	*	*
		Depth	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Changes	*	*	*	*	*	*	*	*	*	*	*	*
		Climate												
Special Features														
Vegetation	Major Species Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
Fish	Major species	*	*	*	*	*	*	*	*	*	*	*	*	
	Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Spawning and Hatching Areas	*	*	*	*	*	*	*	*	*	*	*	*	
	Commercial/Recreational Use	*	*	*	*	*	*	*	*	*	*	*	*	
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
Invertebrates	Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
Amphibians/Reptiles	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	
Avifauna	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	
Mammals	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
Cultural Setting	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Endangered Species													
	Health	*	*	*	*	*	*	*	*	*	*	*	*	
	Population													
	Land Use and Ownership													
	Recreation													
	Mineral, Energy, Forest Resource													
Public Utilities/Facilities														
Point Pollution Sources														
Non-Point Pollution Sources	*	*	*	*	*	*	*	*	*	*	*	*		
Historic Features														
Archaeologic Features		*	*	*	*	*	*	*	*	*	*	*		

LAKE SECTION 2

INTRODUCTION

Lake Section 2 extends along the northeastern shoreline of Lake Michigan from Sevenmile Point northwest of Harbor Springs to Cathead Point at the tip of Leelanau Peninsula. The lake section is situated within Emmet, Charlevoix, Antrim, Grand Traverse, and Leelanau Counties in Michigan, all of which are sparsely populated. Most of the wetlands of Lake Section 2 lie on a low lacustrine plain which is situated lakeward of a hilly till plain. The predominant shore type in the vicinity of the wetlands is erodible low plain featuring a sand and gravel beach. Non-erodible low plain and erodible low bluff are also present (Great Lakes Basin Commission, 1957).

Figures 2-1 and 2-2 show the approximate location of the 24 wetlands in Lake Section 2. Latitude, longitude, acreage, and classification for each of these wetlands are presented in Table 2-1. Elevations range from 585 to 650 feet above sea level (5 to 70 feet above the approximate mean elevation of Lake Michigan). The majority of the wetlands are Palustrine Systems; the remainder Lacustrine or Riverine Systems.

Information related to the physiographic and cultural features of the wetlands of Lake Section 2 is summarized in the individual wetland narratives presented in this chapter. Published sources have yielded no site-specific information on the biotic and hydrologic characteristics of these wetlands.

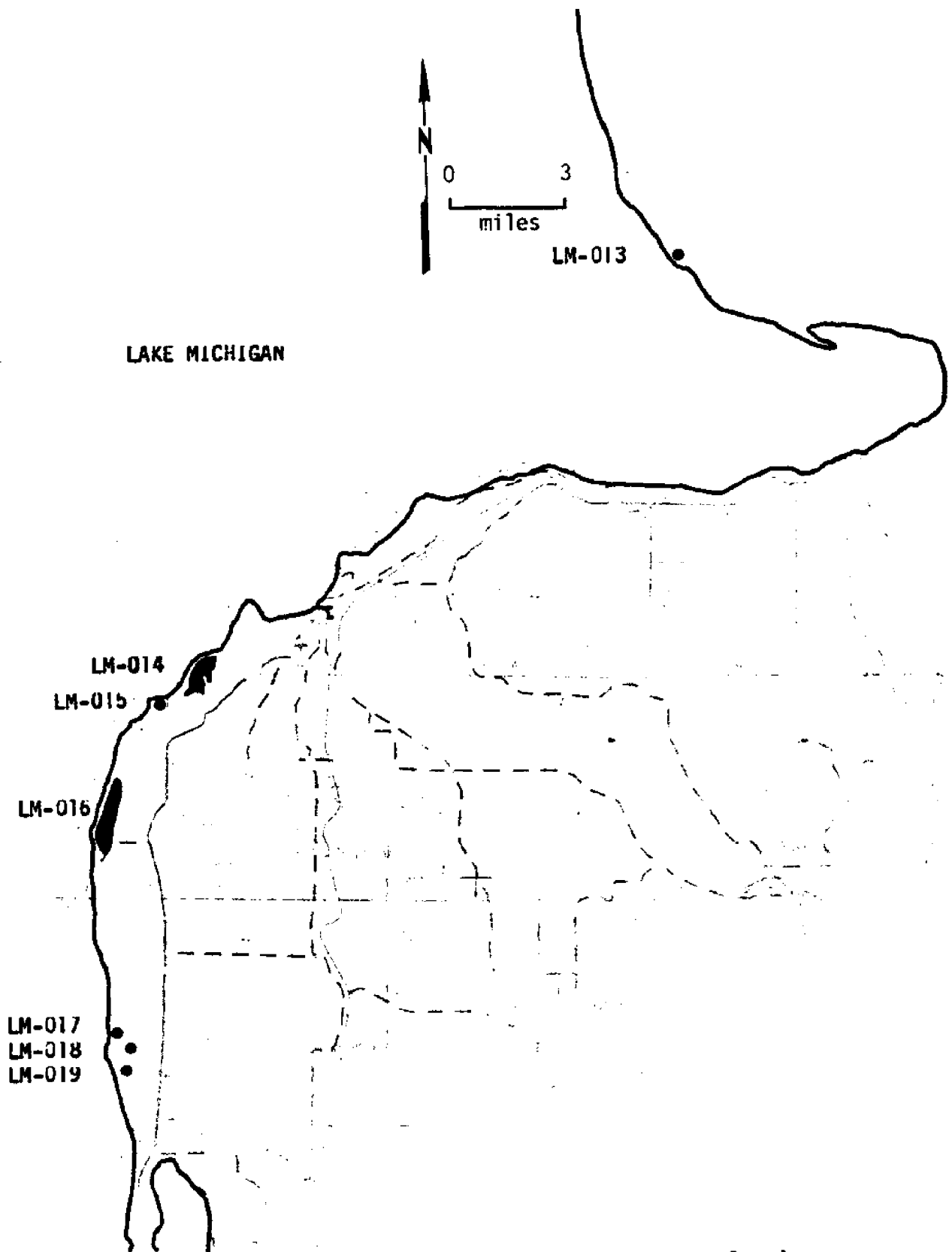


Figure 2-1. Lake Section 2 - Little Traverse Bay Area

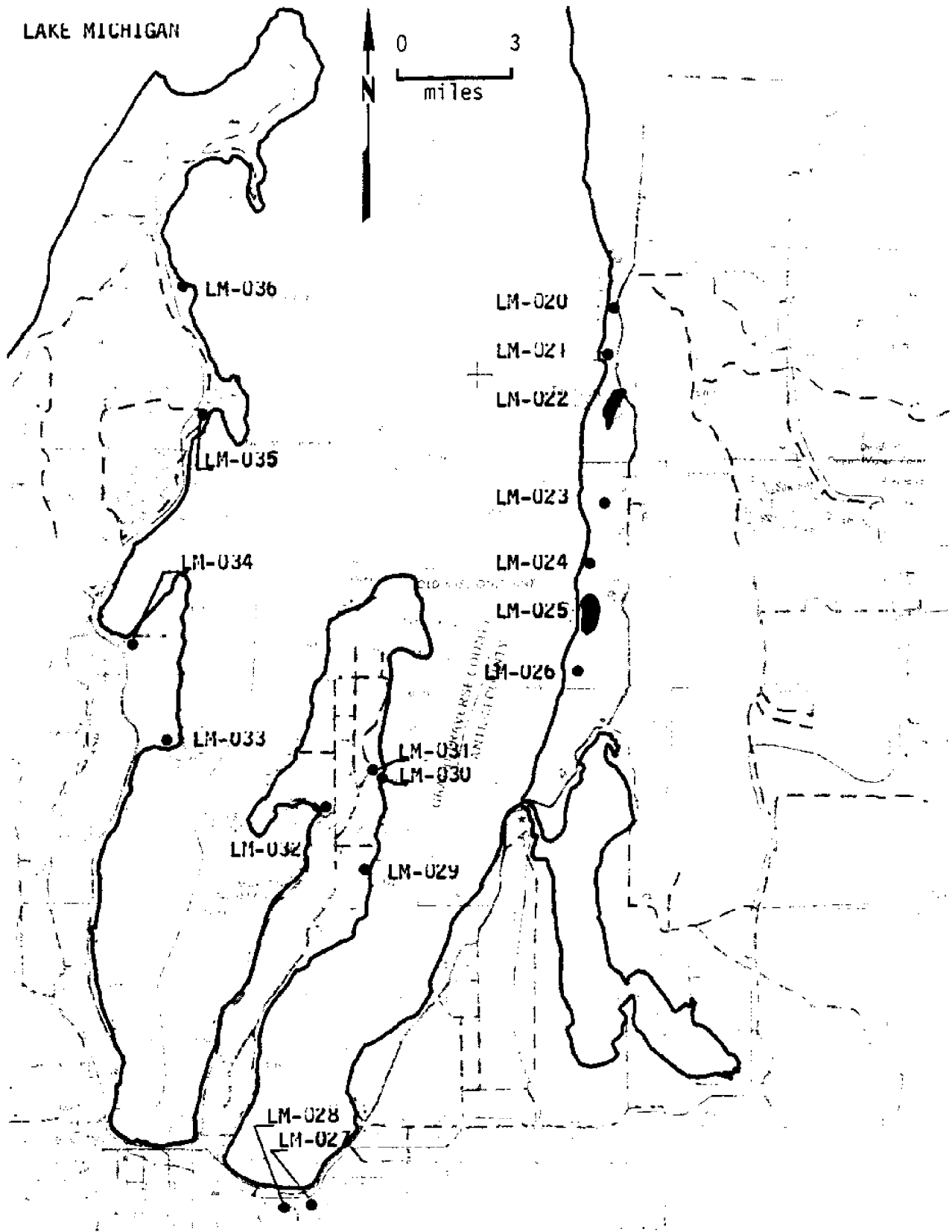


Figure 2-2. Lake Section 2 - Grand Traverse Bay Area
-65-

Table 2-1. Location, Acreage, and Classification of Wetlands
in Lake Section 2

Wetland Number	Wetland	Latitude	Longitude	Acreage	Classification ^a
013	West Traverse Township Wetland	45°27'20"	85°49'40"	2	P
014	McGeach Creek Wetland	45°17'40"	85°18'40"	534	P,R
015	Norwood Township Wetland	45°16'20"	85°21'50"	11	P
016	Whisky Creek Wetland	45°14'40"	85°22'20"	573	P,R
	BANKS TOWNSHIP WETLAND COMPLEX				
017	Banks Township Wetland #1	45°10'00"	85°22'25"	19	P
018	Banks Township Wetland #2	45°09'00"	85°22'20"	57	P
019	Banks Township Wetland #3	45°08'40"	85°22'20"	10	P
020	Torch Lake Township Wetland #1	45°05'45"	85°21'40"	10	P
021	Torch Lake Township Wetland #2	45°04'45"	85°22'00"	6	L
022	Torch Lake Township Wetland #3	45°03'00"	85°22'00"	642	P
023	Torch Lake Township Wetland #4	45°00'20"	85°22'10"	39	P
024	Milton Township Wetland #1	45°59'20"	85°22'55"	19	P
025	Milton Township Wetland #2	45°58'00"	85°22'40"	224	P
026	Paradine Creek Wetland	45°57'00"	85°23'00"	87	P,R
	TRANSVERSE CITY AREA WETLAND COMPLEX				
027	Transverse City Area Wetland #1	45°44'30"	85°31'40"	97	L,R
028	Transverse City Area Wetland #2	45°44'30"	85°33'00"	87	L,R
029	Peninsula Township Wetland #1	45°52'50"	85°30'00"	Drained	
	PENINSULA TOWNSHIP AREA WETLAND COMPLEX				
030	Peninsula Township Wetland #2	45°54'50"	85°29'20"	Drained	
031	Peninsula Township Wetland #3	45°54'55"	85°29'35"	Drained	
032	Bowers Harbor Wetland	44°54'00"	85°31'20"	68	P
033	Lee Point Wetland	44°55'40"	85°36'30"	59	L
034	Suttons Bay Wetland	44°57'23"	85°38'00"	105	P
035	Omena Wetland	45°03'10"	85°35'30"	5	P
036	Ennis Creek Area Wetland	45°06'30"	85°36'30"	13	P

^aP=palustrine
L=lacustrine
R=riverine

WEST TRAVERSE TOWNSHIP WETLAND

PHYSIOGRAPHIC SETTING

LM 013

Setting

West Traverse Township Wetland is located 250 feet inland from the northeast shoreline of Lake Michigan in Emmet County, Michigan, 3.4 miles northwest of the community of Harbor Springs. A steep bluffline, 140 feet high, lies a short distance inland from the wetland, which is a Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958).

Topography

The total relief of West Traverse Township Wetland is 10 feet; wetland elevations range from 600 to 610 feet above sea level, 20 to 30 feet above the approximate mean elevation of Lake Michigan. The wetland lies behind a low bluff, on a hilly morainal plain; inland elevations range to over 1,200 feet above sea level. The Great Lakes West Traverse Township Wetland Basin Commission (1975) describes the shoreline near West Traverse Township Wetland as an erodible low bluff featuring a sand and gravel beach.

Surficial Geology

The surficial geology of West Traverse Township Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in West Traverse Township Wetland is Roscommon mucky sand, which has a surface layer of very dark brown mucky sand with a substratum of light yellowish-brown sand. This soil type is poorly drained and has low available water capacity, low natural fertility, and rapid permeability (Alfred et al., 1973).

Hydrology

There are no streams flowing through West Traverse Township Wetland (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes of West Traverse Township Wetland.

Climate

The closest weather station providing climatic data for West Traverse Township Wetland is located in Petoskey, Michigan. In 1975, the average monthly

temperature was 45.9⁰F, the average daily low for January was 19.2⁰F and the average daily high in July was 79.3⁰F. The average annual precipitation is 37.97 inches, with a mean monthly precipitation of 3.06 inches in January and 2.21 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28⁰F) in 1975 occurring on April 22 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of West Traverse Township Wetland (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958).

BIOTIC SETTING

LM 013

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of West Traverse Township Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in West Traverse Township Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in West Traverse Township Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to West Traverse Township Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to West Traverse Township Wetland. The literature

search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting West Traverse Township Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in West Traverse Township Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 013

Population

West Traverse Township Wetland is located in West Traverse Township of Emmet County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 2-2 indicates that Emmet County and West Traverse Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Emmet County is expected to undergo continued rapid population growth.

Table 2-2. Population Data for the Vicinity of West Traverse Township Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Emmet County	21,211	15.7	27,370
West Traverse Township	573	36.4	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within West Traverse Township Wetland is rural open space. The surrounding area is characterized by rural open space, with a limited amount of agricultural open space. An access road lies inland from West Traverse Township Wetland (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958; Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), but the lack of any apparent developmental activity near the wetland suggests that it is subject to low developmental pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of West Traverse Township Wetland.

Mineral, Energy, and Forest Resources

West Traverse Township Wetland lies within an area underlain by industrial-quality limestones and Silurian salt deposits. However, there are no operations in close proximity to the wetland exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in or near the wetland (Michigan Geological Survey 1977; Smith, 1915).

Although West Traverse Township Wetland is partially wooded (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958), it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of West Travesse Township Wetland (U.S.G.S. quadrangle map, Bayshore, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to West Traverse Township Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of West Traverse Township Wetland (Peebles and Black, 1976). The Michigan Coastal Zone Inventory indicates that one archaeological site (20-EM-20, a habitation of the Woodland Culture) is present in the vicinity of the wetland (Peebles and Black, 1976). Further information regarding the field research and exact location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 013

The literature search identified no on-going or impending research projects pertaining to West Traverse Township.

MCGEACH CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 014

Setting

McGeach Creek Wetland is located 0.1 mile inland from the eastern shoreline of Lake Michigan in Charlevoix County, Michigan, 2.6 miles southwest of the city of Charlevoix. The northern portion of the wetland is situated in the Pigeon River State Forest. The wetland lies on either side of McGeach Creek, a perennial stream flowing in a northwesterly direction into Lake Michigan. From McGeach Creek, the wetland extends southward behind a low line of old, wooded dunes. McGeach Creek Wetland is heavily wooded and occupies a raised site. It is a Riverine (Lower Perennial Subsystem) and Palustrine System (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of McGeach Creek Wetland is 30 feet; wetland elevations range from 590 to 620 feet above sea level, 10 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain which is situated lakeward of a hilly till plain. The lacustrine plain in this area is only about one mile wide; the inland till plain features many drumlins. The shoreline near McGeach Creek Wetland is described by the Great Lakes Basin Commission (1975) as a non-erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of McGeach Creek Wetland is characterized by sand dunes (Martin, 1957).

Soils

There are two soil types found in McGeach Creek Wetland, Tawas muck and Alpena gravelly sandy loam. The former is found along McGeach Creek, and the latter is present throughout the remaining portion of the wetland. Tawas muck consists of organic dark muck over sand, with high available water capacity, low natural fertility, and slow runoff. Tawas muck is a very poorly drained soil generally found in depressional basins or plains. Alpena gravelly sandy loam has a surface layer of very dark brown gravelly sandy loam underlain by brown, very gravelly sand. This soil has low organic content, low natural fertility, and low available water capacity. It is a well-drained soil generally found on beach ridges and sandy plains (Alfred and Hyde, 1974).

Hydrology

McGeach Creek flows northwest through the eastern portion of McGeach Creek Wetland. The creek has an elevational change of approximately 30 feet as it travels through the wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan,

1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in McGeach Creek Wetland.

Climate

The closest weather station providing climatic data for McGeach Creek Wetland is located in Petoskey, Michigan. In 1975, the average monthly temperature was 45.9°F, the average daily low for January was 19.2°F and the average daily high in July was 79.3°F. The average annual precipitation is 37.97 inches, with a mean monthly precipitation of 3.06 inches in January and 2.21 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Fisherman Island lies offshore to the southwest, and a tombolo extends from the shoreline towards the island (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 014

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of McGeach Creek Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in McGeach Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in McGeach Creek Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to McGeach Creek Wetland. The literature search

yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to McGeach Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting McGeach Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in McGeach Creek Wetland by the literature search. However, according to W. L. Gelston (personal communication), an active nest of the osprey (Pandion haliaetus), a species threatened in Michigan, was located in the vicinity of the wetland in 1976.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, a limestone pit is located in the vicinity of this wetland, and may have some affect on its health.

CULTURAL SETTING

LM 014

Population

McGeach Creek Wetland is located in Charlevoix Township of Charlevoix County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 2-3 indicates that Charlevoix County and Charlevoix Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Charlevoix County is expected to undergo continued rapid population growth.

Table 2-3. Population Data for the Vicinity of McGeach Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Charlevoix County	18,467	11.6	25,782
Charlevoix Township	957	32.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within McGeach Creek Wetland is rural open space. The surrounding area is characterized primarily by agricultural and other rural open space uses, with an area of residential, commercial, and industrial development (the city of Charlevoix) northeast of the wetland. A limestone pit is located to the northeast of McGeach Creek Wetland, and an access road lies lakeward of the wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The northern and western portions of the wetland, comprising the greatest part, are under state ownership, while the remainder is under private ownership (Rockford Map Publishers, Inc., 1976). Development pressures for this wetland are likely to be low, owing to the location of the wetland predominantly within state forest holdings.

Recreation

Portions of McGeach Creek Wetland lie within the Pigeon River State Forest. Although there are no known areas specifically designated for recreational use in or near the wetland, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

McGeach Creek Wetland lies within an area underlain by industrial-quality limestones and Silurian salt deposits. A limestone operation exists northeast of the wetland in the South Point area (Gere, 1977). An active sand and gravel pit is also present, lying almost immediately to the east of the wetland (Michigan Department of State Highways and Transportation aerial photograph, 1973). There are no oil, gas, or coal resources in the wetland (Michigan Geological Survey 1977; Smith, 1915).

McGeach Creek Wetland is wooded, but state-owned forest lands in the coastal area are within a "water influence zone" in which water quality, water

use, and aesthetic surroundings are the principal management concerns. Cover treatments are designed to maintain or enhance these concerns, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of McGeach Creek Wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to McGeach Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of McGeach Creek Wetland (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that two archaeological sites of the middle and late archaic cultures are present in the vicinity of the wetland (Peebles and Black, 1976). Further information regarding the field research and exact location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 014

The literature search identified no on-going or impending research projects pertaining to McGeach Creek Wetland.

NORWOOD TOWNSHIP WETLAND

PHYSIOGRAPHIC SETTING

LM 015

Setting

Norwood Township Wetland is located 0.2 mile inland from the eastern shoreline of Lake Michigan in Charlevoix County, Michigan, 5.1 miles southwest of the city of Charlevoix. The wetland lies on a gentle slope, 35 feet above the lake. It is a Palustrine System and occupies a non-wooded site (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Norwood Township Wetland is 5 feet; wetland elevations range from 615 to 620 feet above sea level, 35 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a low, lacustrine plain which lies lakeward of a hilly till plain. The lacustrine plain in this area is less than one mile wide; the inland till plain features many drumlins. The shoreline near Norwood Township Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Norwood Township Wetland is characterized by sand dunes (Martin, 1957).

Soils

The soil type for Norwood Township Wetland is Alpena gravelly sand loam, which has a surface layer of very dark brown gravelly sand loam underlain with brown, very gravelly sand. Alpena gravelly sand loam has a low content of organic matter, low natural fertility, and low available water capacity. It is a well-drained soil generally found on beach ridges and sandy plains (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through Norwood Township Wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Norwood Township Wetland.

Climate

The closest weather station providing climatic data for Norwood Township Wetland is located in Petoskey, Michigan. In 1975, the average monthly

temperature was 45.9°F, the average daily low for January was 19.2°F and the average daily high in July was 79.3°F. The average annual precipitation is 37.97 inches, with a mean monthly precipitation of 3.06 inches in January and 2.21 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Fisherman Island lies to the north of the wetland, and a tombolo extends from the shoreline towards the island (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 015

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Norwood Township Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Norwood Township Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Norwood Township Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Norwood Township Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the

relevance of this information to Norwood Township Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Norwood Township Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Norwood Township Wetland by the literature search. However, according to W. L. Gelston (personal communication), an active nest of the osprey (Pandion haliaetus), a species threatened in Michigan, was located in the vicinity of the wetland in 1976.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 015

Population

Norwood Township Wetland is located in Norwood Township of Charlevoix County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 2-4 indicates that Charlevoix County and Norwood Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Charlevoix County is expected to undergo continued rapid population growth.

Table 2-4. Population Data for the Vicinity of Norwood Township Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Charlevoix County	18,467	11.6	25,782
Norwood Township	451	38.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Norwood Township Wetland is rural open space. The surrounding area is in agricultural and other rural open space uses (Michigan Department of State Highways and Transportation aerial photograph, 1973). Since the wetland lies within the platted area of Clipper View (Rockford Map Publishers, Inc., 1976); it is assumed that the wetland is under private ownership, and its location suggests that Norwood Township Wetland is subject to moderate development pressures. An access road lies lakeward of Norwood Township Wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in Norwood Township Wetland. The Pigeon River State Forest is located approximately 0.5 mile south of the wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954).

Mineral, Energy, and Forest Resources

Norwood Township Wetland lies within an area underlain by industrial-quality limestones and Silurian salt deposits. However, there are no operations exploiting these resources in close proximity to the wetland (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey 1977; Smith, 1915).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Norwood Township Wetland (U.S.G.S. quadrangle map, Charlevoix, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Norwood Township Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Norwood Township Wetland (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that nine archaeological sites are present in the vicinity of the wetland. Sites 20-CX-7, 20-CX-18, 20-CX-22, 20-CX-34, 20-CX-35, 20-CX-36, and 20-CX-39 are all habitations occupied from the Archaic to Late Woodland Periods, and sites 20-CX-20 and 20-CX-21 are chert quarries (Peebles and Black, 1976). Further information regarding the field research and exact location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 015

The literature search identified no on-going or impending research projects pertaining to Norwood Township Wetland.

WHISKEY CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 016

Setting

Whiskey Creek Wetland is located 250 feet inland from the eastern shoreline of Lake Michigan in Charlevoix County, Michigan, 0.2 mile north of the community of Norwood. The wetland is situated on a broad headland which separates Little Traverse Bay and Grand Traverse Bay, and all but a small portion lies within the Pigeon River State Forest.

Whiskey Creek Wetland is a Palustrine and Riverine System; it is heavily wooded and occupies a raised site (U.S.G.S. quadrangle maps, Charlevoix, Michigan, 1954, and Central Lake, Michigan, 1954; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Whiskey Creek Wetland is 40 feet; wetland elevations range from 620 to 660 feet above sea level, 40 to 80 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain which lies lakeward of a hilly till plain. The lacustrine plain in this area is less than one mile wide; the inland till plain features many drumlins and small lakes. The shoreline near Whiskey Creek Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Whiskey Creek Wetland is characterized by sand dunes and lake beds of sand. The lake beds are composed of various glaciolacustrine sediments, mainly sand, and consist of the fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Whiskey Creek Wetland is Eastport sand. Eastport sand has been altered by shifting wind, which has prevented the formation of a distinct soil profile. This soil ranges from dark grayish-brown sand to light brownish-gray sand which has low natural fertility, low organic matter content, and low available water capacity. It is well drained and is generally found on beach ridges and low dunes (Alfred and Hyde, 1974).

Hydrology

Whiskey Creek flows westward through Whiskey Creek Wetland. This creek originates in the adjacent upland and has an elevational change of approximately 20 feet as it travels through the wetland. An unnamed, intermittent stream

flows westward through the northern part of Whiskey Creek Wetland (U.S.G.S. quadrangle maps, Charlevoix, Michigan, 1954, and Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Whiskey Creek Wetland.

Climate

The closest weather station providing climatic data for Whiskey Creek Wetland is located in East Jordan, Michigan. In 1975, the average monthly temperature was 45.5°F, the average daily low for January was 17.1°F and the average daily high in July was 81.9°F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately five and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Small sand spits are located along the beachline (U.S.G.S. quadrangle maps, Charlevoix, Michigan, 1954, and Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 016

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Whiskey Creek Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Whiskey Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Whiskey Creek Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the

relevance of this information to Whiskey Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4, and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Whiskey Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Whiskey Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Whiskey Creek Wetland by the literature search. However, according to W. L. Gelston (personal communication), an active nest of the osprey (Pandion haliaetus), a species threatened in Michigan, was located in the vicinity of the wetland in 1976.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 016

Population

Whiskey Creek Wetland is located in Norwood Township of Charlevoix County, Michigan. The county is sparsely populated, having a density of 40 persons per square mile. Table 2-5 indicates that Charlevoix County and Norwood Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Charlevoix County is expected to undergo continued rapid population growth.

Table 2-5. Population Data for the Vicinity of Whiskey Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Charlevoix County	18,467	11.6	25,782
Norwood Township	451	38.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Whiskey Creek Wetland is rural open space. The surrounding area is characterized by rural open space uses, including agricultural to the east, but a small area of residential development (the community of Norwood) lies south of the wetland. An access road lies lakeward of most of Whiskey Creek Wetland (U.S.G.S. quadrangle maps, Charlevoix, Michigan, 1954, and Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Michigan Department of State Highways and Transportation aerial photograph, 1973). The major part of the wetland is under state ownership; areas of private ownership occur along the southwestern periphery (Rockford Map Publishers, Inc., 1976). The presence of residential and agricultural land use surrounding Whiskey Creek Wetland suggests that the privately owned portions of the wetland may face moderate development pressures. The portion of the wetland that lies within the Pigeon River State Forest is likely to have low development pressures.

Recreation

Although there are no known areas specifically designated for recreational use in or near the wetland, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

Whiskey Creek Wetland lies within an area underlain by industrial-quality limestones and Silurian salt deposits. However, there are no operations exploiting these resources in close proximity to the wetland (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Whiskey Creek Wetland is heavily wooded, but state-owned forest lands in the coastal area are within a "water influence zone" in which water quality, water use, and aesthetic surroundings are the principal management concerns.

Cover treatments are designed to maintain or enhance these concerns, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Whiskey Creek Wetland (U.S.G.S. quadrangle maps, Central Lake Michigan, 1954; Charlevoix, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Whiskey Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Whiskey Creek Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 016

The literature search identified no on-going or impending research projects pertaining to Norwood Township Wetland.

BANKS TOWNSHIP WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 017-019

Setting

The Banks Township Wetland Complex, comprised of Banks Township Wetlands #1-#3, is located near the eastern shoreline of Lake Michigan in Antrim County, Michigan. Each of these wetlands lies approximately 0.2 mile from the lake shore; their respective distances from the community of Eastport are given in Table 2-6.

Table 2-6. Location of Banks Township Wetlands #1-#3

	Distance to Eastport, Michigan
Banks Township Wetland #1	4.0 miles north/northwest
Banks Township Wetland #2	3.0 miles north/northeast
Banks Township Wetland #3	2.8 miles north/northeast

All three of these wetlands are Palustrine Systems and occupy raised, wooded sites (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

Elevations within the Banks Township Wetland Complex range from 610 to 635 feet above sea level. Elevations and total relief of the individual wetlands are presented in Table 2-7.

Table 2-7. Elevations and Total Relief of Individual Wetlands
in Banks Township Wetlands #1-#3

	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet)
Banks Township Wetland #1	625	635	10
Banks Township Wetland #2	610	620	10
Banks Township Wetland #3	610	620	10

^a Elevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level.

Banks Township Wetlands #1-#3 are situated on a narrow lacustrine plain which lies lakeward of a hilly till plain. The lacustrine plain in this area is less than one mile wide; the inland till plain features many drumlins and small lakes. The shoreline near Banks Township Wetlands #1-#3 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Banks Township Wetlands #1-#3 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Banks Township Wetlands #1 and #3 is Antrim gravelly sandy loam; the soil type in Banks Township Wetland #2 is Rifle peat. Antrim gravelly sandy loam has a surface layer of dark grayish-brown sandy loam underlain with coarse clay loam, gravel, and a lower layer of sand and gravel. This soil contains organic matter and is moderately fertile. Antrim gravelly sandy loam has poor subsurface drainage in places. Rifle peat consists of woody and coarse material and is high in organic matter. It has a subsurface of fibrous and incompletely decomposed peat and may be underlain by clay or sand (Veatch et al., 1928).

Hydrology

There are no streams flowing through Banks Township Wetlands #1-#3 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Banks Township Wetlands #1-#3.

Climate

The closest weather station providing climatic data for Banks Township Wetlands #1-#3 is located in East Jordan, Michigan. In 1975, the average monthly temperature was 45.5°F, the average daily low for January was 17.1°F and the average daily high in July was 81.9°F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately five and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Banks Township Wetland Complex (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 017-019

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of the Banks Township Wetlands #1-#3.

Fish

Species found in the Grand Traverse Bay region which are general in distribution and commonly occur in wetlands or which prefer or depend on wetland habitats during all or part of their life cycles include longnose gar (Lepistosteus osseus), bowfin (Amia calva), central mudminnow (Umbra limi), carp (Cyprinus carpio), goldenshiner (Notemigonus crysoleucas), blacknose shiner (Notropis heterolepis), blackchin shiner (Notropis heterodon), white sucker (Catostomus commersoni), northern pike (Esox lucius), muskellunge (Esox masquinongy), yellow bullhead (Ictalurus natalis), brown bullhead (Ictalurus nebulosus), black bullhead (Ictalurus melas), banded killifish (Fundulus diaphanus), brook stickleback (Culaea inconstans), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), black crappie (Pomoxis nigromaculatus), rock bass (Ambloplites rupestris), smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), logperch (Percina caprodes), johnny darter (Etheostoma nigrum), Iowa darter (Etheostoma exile), and mottled sculpin (Cottus bairdi) (Price and Kelly, 1976). The diversity of the fish communities in small Palustrine coastal wetlands with no surface water connections to the bay or adjacent large lakes, such as Torch Lake and Elk Lake, is probably much less than those communities of the larger Lacustrine and Riverine wetlands. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Banks Township Wetlands #1-#3.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Banks Township Wetlands #1-#3.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to the Banks Township Wetland Complex. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland complex.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to the Banks Township Wetland Complex. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland complex.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the three wetlands comprising the Banks Township Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Banks Township Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland complex.

CULTURAL SETTING

LM 017-019

Population

Banks Township Wetlands #1-#3 are located in Banks Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-8 indicates that Antrim County and Banks

Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-8. Population Data for the Vicinity of Banks Township Wetlands #1-#3

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Banks Township	1,407	14.3	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Banks Township Wetlands #1-#3 is rural open space. The area surrounding these wetlands is characterized primarily by agricultural and other rural open space uses, with rural residences scattered throughout the area (Agricultural Stabilization and Conservation Service aerial photograph, 1973). The wetlands are under private ownership (Rockford Map Publishers, Inc., 1975), but the agricultural nature of the area suggests that Banks Township Wetlands #1-#3 are subject to low to moderate development pressures. Access roads are located near all of the wetlands in the Banks Township Wetland Complex (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of the Banks Township Wetland Complex.

Mineral, Energy, and Forest Resources

Banks Township Wetlands #1-#3 lie within an area of shale outcroppings and Silurian salt deposits. A shale pit is situated to the east of Banks Township Wetland #2, but no operations in or near the wetlands currently exploit the salt resources (Gere, 1977). There are two sand and gravel operations east of Banks Township Wetlands #1 and #2, and four more pits southeast of Banks Township #3 (Michigan Department of State Highways and Transportation aerial photograph, 1973). No oil, gas, or coal resources are present in the vicinity of the wetlands (Michigan Geological Survey, 1977; Smith, 1915).

Banks Township Wetlands #1-#3 are wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether these wooded areas are used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Banks Township Wetlands #1-#3 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Banks Township Wetlands #1-#3 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Banks Township Wetlands #1-#3 (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that two archaeological sites (20-AN-27 and 20-AN-28, of the Archaic-Early Woodland Cultures) are present in the vicinity of the wetlands (Peebles and Black, 1976). Further information regarding the field research and exact location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 017-019

The literature search identified no on-going or impending research projects pertaining to Banks Township Wetlands #1-#3.

TORCH LAKE TOWNSHIP WETLAND #1

PHYSIOGRAPHIC SETTING

LM 020

Setting

Torch Lake Township Wetland #1 is located 0.1 mile inland from the eastern shoreline of Lake Michigan in Antrim County, Michigan, 0.7 mile southwest of the community of Eastport. The wetland is a Palustrine System and occupies a raised, wooded site on an isthmus separating Torch Lake from Lake Michigan (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Torch Lake Township Wetland #1 is 5 feet; wetland elevations range from 610 to 615 feet above sea level, 30 to 35 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a narrow, low lacustrine plain which lies lakeward of Torch Lake and a hilly till plain. The inland till plain features many drumlins and small lakes. The shoreline near Torch Lake Township Wetland #1 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Torch Lake Township Wetland #1 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Torch Lake Township Wetland #1 is Lupton muck, which consists of black or brown loamy muck. This soil is high in organic matter, but generally is more decomposed and has a higher ash content than peat soils. Lupton muck is usually underlain by marl or clay, but may be underlain by sand (Veatch et al., 1928).

Hydrology

There are no streams flowing through Torch Lake Township Wetland #1 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Torch Lake Township Wetland #1.

Climate

The closest weather station providing climatic data for Torch Lake Township Wetland #1 is located in East Jordan, Michigan. In 1975, the average monthly temperature was 45.5°F, the average daily low for January was 17.1°F and the average daily high in July was 81.9°F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Torch Lake Township Wetland #1 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center, aerial reconnaissance, 1978).

BIOTIC SETTING

LM 020

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Torch Lake Township Wetland #1.

Fish

Species expected to be associated with coastal wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species probably occur in Torch Lake Township Wetland #1. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Torch Lake Township Wetland #1.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Torch Lake Township Wetland #1.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #1. The literature

search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #1. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Torch Lake Township Wetland #1.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Torch Lake Township Wetland #1 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 020

Population

Torch Lake Township Wetland #1 is located in Torch Lake Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-9 indicates that Antrim County and Torch Lake Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-9. Population Data for the Vicinity of Torch Lake Township Wetland #1

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Torch Lake Township	543	38.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Torch Lake Township Wetland #1 is rural open space. The surrounding area is characterized by rural open space, with limited shoreline residential development (U.S.G.S. orthophotograph, Central Lake SE, Michigan, 1975). The wetland lies within a platted area near the community of Eastport. It is assumed that the wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate to heavy development pressures. An access road lies to the south of Torch Lake Township Wetland #1 and a secondary highway lies to the east (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of Torch Lake Township Wetland #1.

Mineral, Energy, and Forest Resources

Torch Lake Township Wetland #1 lies within an area of known shale outcroppings and Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Torch Lake Township Wetland #1 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Torch Lake Township Wetland #1 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Torch Lake Township Wetland #1 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Torch Lake Township Wetland #1, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 020

The literature search identified no on-going or impending research projects pertaining to Torch Lake Township #1.

TORCH LAKE TOWNSHIP WETLAND #2

PHYSIOGRAPHIC SETTING

LM 021

Setting

Torch Lake Township Wetland #2 is located 0.1 mile inland from the eastern shoreline of Grand Traverse Bay in Antrim County, Michigan, 0.4 mile west of the community of Torch Lake. The wetland is a Lacustrine System and occupies a low, wooded site on an isthmus separating Torch Lake from Lake Michigan (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Torch Lake Township Wetland #2 is 5 feet; wetland elevations range from approximately 585 to 590 feet above sea level, 5 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a narrow, low, lacustrine plain situated lakeward of a hilly till plain. The inland till plain features many drumlins and small lakes. The shoreline near Torch Lake Township Wetland #2 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Torch Lake Township Wetland #2 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Torch Lake Township Wetland #2 is Bridgeman sand, which ranges from dark gray to yellowish sand. The surface layer of this soil contains organic material and has sufficient moisture to support a varied vegetation (Veatch et al., 1928).

Hydrology

There are no streams flowing through Torch Lake Township Wetland #2 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Torch Lake Township Wetland #2.

Climate

The closest weather station providing climatic data for Torch Lake Township Wetland #2 is located in East Jordan, Michigan. In 1975, the average monthly temperature was 45.5°F, the average daily low for January was 17.1°F and

the average daily high in July was 81.9°F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Torch Lake Township Wetland #2 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center, aerial reconnaissance, 1978).

BIOTIC SETTING

LM 021

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Torch Lake Township Wetland #2.

Fish

Species expected to be associated with coastal wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Torch Lake Township Wetland #2. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Torch Lake Township Wetland #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Torch Lake Township Wetland #2.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #2. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Torch Lake Township Wetland #2.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Torch Lake Township Wetland #2 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 021

Population

Torch Lake Township Wetland #2 is located in Torch Lake Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-10 indicates that Antrim County and Torch Lake Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-10. Population Data for the Vicinity of Torch Lake Township Wetland #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Torch Lake Township	543	38.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Torch Lake Township Wetland #1 is rural open space. The surrounding area is characterized by agricultural and other rural open space uses, with limited residential development to the east of the wetland (U.S.G.S. orthophotograph, Central Lake SE, Michigan, 1975). The wetland lies within an unincorporated area of small privately owned tracts (Rockford Map Publishers, Inc., 1975). Although no specific development plans were identified through the literature search for Torch Lake Township Wetland #2, it appears that the land has been divided into parcels in such a manner as to facilitate development. An access road lies to the south of Torch Lake Township Wetland #2, and a pond lies lakeward from the wetland (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of Torch Lake Township Wetland #2.

Mineral, Energy, and Forest Resources

Torch Lake Township Wetland #2 lies within an area of known shale outcroppings and Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Torch Lake Township Wetland #2 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Torch Lake Township Wetland #2 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Torch Lake Township Wetland #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Torch Lake Township Wetland #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 021

The literature search identified no on-going or impending research projects pertaining to Torch Lake Township #2.

TORCH LAKE TOWNSHIP WETLAND #3

PHYSIOGRAPHIC SETTING

LM 022

Setting

Torch Lake Township Wetland #3 is located 350 feet inland from the eastern shoreline of Grand Traverse Bay in Antrim County, Michigan, 0.6 mile south of the community of Torch Lake. Torch Lake Township Wetland #3 is situated on an isthmus separating Torch Lake from Lake Michigan. The northeastern portion of the wetland (on either side of Highway 31) has been drained, and the forest has been cut. Torch Lake Township Wetland #3 is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center, aerial reconnaissance, 1978).

Topography

The total relief of Torch Lake Township Wetland #3 is 40 feet; wetland elevations range from 590 to 630 feet above sea level, 10 to 50 feet above the approximate mean elevation of Lake Michigan. The wetland #3 is situated on a narrow, low lacustrine plain which lies lakeward of both Torch Lake and a hilly till plain. The inland till plain features many drumlins and small lakes. The shoreline near Torch Lake Township Wetland #3 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Torch Lake Township Wetland #3 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

Three soil types are found in Torch Lake Township Wetland #3: Saugatuck sand, Ogemaw sandy loam, and Newton sandy loam. Saugatuck sand consists of dark gray or black loamy material mixed with organic matter, underlain by a layer of nearly white, incoherent sand and yellowish-brown mottled wet sand. This soil is strongly acid and has low natural fertility. Saugatuck sand developed under poor drainage conditions on wet flats and may include areas of muck. Ogemaw sandy loam consists of fine to medium sand mixed with organic material, underlain with reddish-brown calcareous clay; this soil is poorly drained when found in depressional areas. Newton sandy loam has a surface layer containing a high amount of organic matter, underlain with grayish water-logged sand and a substratum of clay. This soil is generally found in wet or poorly drained areas (Veatch et al., 1928).

Hydrology

There are no streams flowing through Torch Lake Township Wetland #3 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Torch Lake Township wetland #3.

Climate

The closest weather station providing climatic data for Torch Lake Township Wetland #3 is located in East Jordan, Michigan. In 1975, the average monthly temperature was 45.5 F, the average daily low for January was 17.1 F and the average daily high in July was 81.9 F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately five and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Torch Lake Township Wetland #3 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center, aerial reconnaissance, 1978).

BIOTIC SETTING

LM 022

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Torch Lake Township Wetland #3.

Fish

Species expected to be associated with coastal wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Torch Lake Wetland #3. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Torch Lake Township Wetland #3.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity,

food sources, or relationship to water levels of the invertebrates present in Torch Lake Township Wetland #3.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #3. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #3. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Torch Lake Township Wetland #3.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Torch Lake Township Wetland #3 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 022

Population

Torch Lake Township Wetland #3 is located in Torch Lake Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-11 indicates that Antrim County and Torch Lake Township both experienced a rapid rate of population growth between 1970 and

1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-11. Population Data for the Vicinity of Torch Lake Township Wetland #3

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Torch Lake Township	543	38.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Torch Lake Township Wetland #3 is rural open space. The surrounding area is characterized by agricultural open space to the east, and by shoreline residential development along Lake Michigan to the west and along Torch Lake to the east (U.S.G.S. orthophotograph, Central Lake SE, Michigan, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that development pressures are moderate to high. Access roads and a secondary highway lie within Torch Lake Township Wetland #3. A boat dock lies along the shoreline near the wetland (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of Torch Lake Township Wetland #3.

Mineral, Energy, and Forest Resources

Torch Lake Township Wetland #3 lies within an area of known shale outcroppings and Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Torch Lake Township Wetland #3 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Torch Lake Township Wetland #3 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Torch Lake Township Wetland #3 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Torch Lake Township Wetland #3, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 022

The literature search identified no on-going or impending research projects pertaining to Torch Lake Township #3.

TORCH LAKE TOWNSHIP WETLAND #4

PHYSIOGRAPHIC SETTING

LM 023

Setting

Torch Lake Township Wetland #4 is located 0.2 mile inland from the eastern shoreline of Grand Traverse Bay in Antrim County, Michigan, 4.6 miles south of the community of Torch Lake. The wetland is situated on an isthmus separating Torch Lake from Lake Michigan. The wetland is a Palustrine System and occupies a raised, wooded site (U.S.G.S. orthophotograph, Central Lake S.E., Michigan, 1975; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Topography

The total relief of Torch Lake Township Wetland #4 is 10 feet; wetland elevations range from 640 to 650 feet above sea level, 60 to 70 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a hilly till plain; nearby elevations range to over 800 feet above sea level. The Great Lakes Basin Commission (1975) describes the shoreline near Torch Lake Township Wetland #4 as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Torch Lake Township Wetland #4 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Torch Lake Township Wetland #4 is Lupton muck, which consists of black or brown loamy muck that is high in organic matter. This soil is generally highly decomposed and has a higher ash content than peat soils; it is usually underlain by marl or clay but may be underlain by sand (Veatch et al., 1928).

Hydrology

There are no streams flowing through Torch Lake Township Wetland #4 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Torch Lake Township Wetland #4.

Climate

The closest weather station providing climatic data for Torch Lake Township Wetland #4 is located in East Jordan, Michigan. In 1975, the average

monthly temperature was 45.5°F, the average daily low for January was 17.1°F and the average daily high in July was 81.9°F. The average annual precipitation is 31.37 inches, with a mean monthly precipitation of 1.83 inches in January and 3.15 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a half months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on October 26 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Torch Lake Township Wetland #4 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954; U.S.G.S. orthophotograph, Central Lake S.E., Michigan, 1975; Indiana University, Environmental Systems Application Center, aerial reconnaissance, 1978).

BIOTIC SETTING

LM 023

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Torch Lake Township Wetland #4.

Fish

Species expected to be associated with coastal wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Torch Lake #4. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Torch Lake Township Wetland #4.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Torch Lake Township Wetland #4.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #4. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Torch Lake Township Wetland #4. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Torch Lake Township Wetland #4.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Torch Lake Township Wetland #4 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 023

Population

Torch Lake Township Wetland #4 is located in Torch Lake Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-12 indicates that Antrim County and Torch Lake Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-12. Population Data for the Vicinity Torch Lake Township Wetland #4

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Torch Lake Township	543	38.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Torch Lake Township Wetland #4 is rural open space. The surrounding area is characterized by rural open space to the west, and agricultural open space to the east (U.S.G.S. orthophotograph, Central Lake SE, Michigan, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), but its location suggests that development pressures are low to moderate.

Recreation

There are no known state or federal recreational facilities in the vicinity of Torch Lake Township Wetland #4.

Mineral, Energy, and Forest Resources

Torch Lake Township Wetland #4 lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Torch Lake Township Wetland #4 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Torch Lake Township Wetland #4 (U.S.G.S. quadrangle map, Central Lake, Michigan, 1954).

Pollution Sources

There are no NPDES permit holders adjacent to Torch Lake Township Wetland #4 (Michigan Water Quality Division, 1978). No site-specific information was

located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Torch Lake Township Wetland #4, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 023

The literature search identified no on-going or impending research projects pertaining to Torch Lake Township #4.

MILTON TOWNSHIP WETLAND #1

PHYSIOGRAPHIC SETTING

LM 024

Setting

Milton Township Wetland #1 is located 0.1 mile inland from the eastern shoreline of the East Arm of Grand Traverse Bay in Antrim County, Michigan, 4.2 miles north of the community of Kewadin. The wetland is situated on an isthmus separating Torch Lake from Lake Michigan. It is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Milton Township Wetland #1 is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain situated lakeward of Torch Lake and a hilly till plain. This lacustrine plain is less than one mile wide; the inland till plain features many small lakes. The Great Lakes Basin Commission (1975) describes the shoreline near Milton Township Wetland #1 as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Milton Township Wetland #1 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin 1957; Dorr and Eschman, 1970).

Soils

The soil type in Milton Township Wetland #1 is Saugatuck sand, which consists of dark gray or black loamy material mixed with organic matter, underlain by a layer of nearly white, incoherent sand and yellowish-brown mottled wet sand. This soil is strongly acid and has low natural fertility. Saugatuck sand developed under poor drainage conditions on wet flats and may include areas of muck (Veatch et al., 1928).

Hydrology

There are no streams flowing through Milton Township Wetland #1 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Milton Township Wetland #1.

Climate

The closest weather station providing climatic data for Milton Township Wetland #1 is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Milton Township Wetland #1 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 024

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Milton Township Wetland #1.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Milton Township Wetland #1. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Milton Township Wetland #1.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Milton Township Wetland #1.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Milton Township Wetland #1. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use,

life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Milton Township Wetland #1. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Milton Township Wetland #1.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Milton Township Wetland #1 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 024

Population

Milton Township Wetland #1 is located in Milton Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-13 indicates that Antrim County and Milton Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-13. Population Data for the Vicinity of Milton Township Wetland #1

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Milton Township	1,099	28.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Milton Township Wetland #1 is rural open space. The surrounding area is characterized by agricultural and other rural open space uses, with limited residential development along Grand Traverse Bay (Michigan Department of State Highways and Transportation aerial photograph, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Milton Township Wetland #1.

Mineral, Energy, and Forest Resources

Milton Township Wetland #1 lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Milton Township Wetland #1 is wooded (Indiana University Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Milton Township Wetland #1 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Milton Township Wetland #1 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Milton Township Wetland #1, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 024

The literature search identified no on-going or impending research projects pertaining to Milton Township #1.

MILTON TOWNSHIP WETLAND #2

PHYSIOGRAPHIC SETTING

LM 025

Setting

Milton Township Wetland #2 is located 250 feet inland from the eastern shoreline of the East Arm of Grand Traverse Bay, in Antrim County, Michigan, 4.2 miles north of the City of Elk Rapids. The wetland is situated on an isthmus separating Torch Lake from Lake Michigan, within a series of coastal beach ridges that parallels the shoreline. Milton Township Wetland #2 is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Milton Township Wetland #2 is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain situated lakeward of Torch Lake and a hilly till plain. This lacustrine plain is less than one mile wide; the inland till plain features many small lakes. The Great Lakes Basin Commission (1975) describes the shoreline near Milton Township Wetland #2 as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Milton Township Wetland #2 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil types in Milton Township Wetland #2 are Bridgeman sand and Saugatuck sand. Saugatuck sand consists of dark gray or black loamy material mixed with organic matter, underlain by a layer of nearly white, incoherent sand and yellowish-brown mottled wet sand. This soil is strongly acid and has low natural fertility. Saugatuck sand developed under poor drainage conditions on wet flats and may include areas of muck. Bridgeman sand ranges from dark gray to yellowish sand. Its surface layer contains organic material and has sufficient moisture to support a varied vegetation. Bridgeman sand is generally found in areas bordering Traverse Bay (Veatch et al., 1928).

Hydrology

There are no streams flowing through Milton Township Wetland #2 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957). The literature search provided no

site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Milton Township Wetland #2.

Climate

The closest weather station providing climatic data for Milton Township Wetland #2 is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Milton Township Wetland #2 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 025

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Milton Township Wetland #2.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Milton Township Wetland #2. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Milton Township Wetland #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Milton Township Wetland #2.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Milton Township Wetland #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Milton Township Wetland #2. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Milton Township Wetland #2.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Milton Township Wetland #2 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 025

Population

Milton Township Wetland #2 is located in Milton Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-14 indicates that Antrim County and Milton Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-14. Population Data for the Vicinity of Milton Township Wetland #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Milton Township	1,099	28.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Milton Township Wetland #2 is rural open space. The surrounding area is characterized by agricultural and other rural open space uses, with limited residential development along Grand Traverse Bay (Michigan Department of State Highways and Transportation aerial photograph, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate development pressures. A secondary highway lies inland from Milton Township Wetland #2 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of Milton Township Wetland #2.

Mineral, Energy, and Forest Resources

Milton Township Wetland #2 lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Milton Township Wetland #2 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Milton Township Wetland #2 (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Milton Township Wetland #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Milton Township Wetland #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 025

The literature search identified no on-going or impending research projects pertaining to Milton Township #2.

PARADINE CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 026

Setting

Paradine Creek Wetland is located 0.1 mile inland from the eastern shoreline of the East Arm of Grand Traverse Bay in Antrim County, Michigan, 1.4 miles north of the community of Kewadin. The wetland is not wooded, but it is surrounded by dense forest. Paradine Creek Wetland is a low perennial Riverine and Palustrine System and occupies a raised site (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Paradine Creek Wetland is approximately 15 feet; wetland elevations range from 585 to 600 feet above sea level, 5 to 20 feet above the approximate mean elevation of Lake Michigan. A low line of dunes parallels the shoreline lakeward of the wetland. Paradine Creek Wetland lies on a low lacustrine plain situated lakeward of both Torch Lake and a hilly till plain. This lacustrine plain is less than a mile wide; the inland till plain features many small lakes. The Great Lakes Basin Commission (1975) describes the shoreline near Paradine Creek Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Paradine Creek Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil types in Paradine Creek Wetland are Rifle peat and Bridgeman sand. Rifle peat consists of woody and coarse material and is high in organic matter, with a subsurface of fibrous and incompletely decomposed peat which may be underlain by clay or sand. Bridgeman sand ranges from dark gray to yellowish sand. The surface layer of this soil contains organic material and has sufficient moisture to support a varied vegetation. Bridgeman sand is generally found in areas bordering Traverse Bay (Veatch et al., 1928).

Hydrology

Paradine Creek has little elevational change as it flows through Paradine Creek Wetland into Grand Traverse Bay. The creek originates in the upland area to the east of the wetland. Two unnamed open-water areas are also present in the wetland, and the largest of these is connected to Paradine Creek (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957).

The literature search provided no site-specific information pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Paradine Creek Wetland.

Climate

The closest weather station providing climatic data for Paradine Creek Wetland is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Paradine Creek Wetland (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 026

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Paradine Creek Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Paradine Creek Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Paradine Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Paradine Creek Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Paradine Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Paradine Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Paradine Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Paradine Creek Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

Population

Milton Township Wetland #2 is located in Milton Township of Antrim County, Michigan. The county is sparsely populated, having a density of 26 persons per square mile. Table 2-15 indicates that Antrim County and Milton Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Antrim County is expected to undergo continued rapid population growth.

Table 2-15. Population Data for the Vicinity of Paradine Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Antrim County	15,314	21.4	21,922
Milton Township	1,099	28.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Paradine Creek Wetland is rural open space. The surrounding area is characterized by agricultural and other rural open space uses, with limited residential development along Grand Traverse Bay (Michigan Department of State Highways and Transportation aerial photograph, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate development pressures. An access road is located lakeward of Paradine Creek Wetland (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Recreation

There are no known state or federal recreational facilities in the vicinity of Paradine Creek Wetland.

Mineral, Energy, and Forest Resources

Paradine Creek Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). An active sand and gravel pit is located southeast of the wetland (Michigan Department of State Highways and Transportation aerial photograph, 1973). There are no oil, gas, or coal resources in the wetland (Michigan 1977; Smith, 1915). Paradine Creek Wetland contains no significant forest resources (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Paradine Creek Wetland (U.S.G.S. quadrangle map, Elk Rapids, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Paradine Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Paradine Creek Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 026

The literature search identified no on-going or impending research projects pertaining to Paradine Creek Wetland.

TRAVERSE CITY AREA WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 027-028

Setting

The Traverse City Area Wetland Complex is comprised of Traverse City Area Wetlands #1 and #2. The complex is located at the head of the East Arm of Grand Traverse Bay in Grand Traverse County, Michigan. Both wetlands lie 0.1 mile inland; Traverse City Area Wetland #1 is situated 1.2 miles to the east of Traverse City, and Traverse City Area Wetland #2 is adjacent to the city. Both wetlands are lower perennial Riverine and Lacustrine Systems; they occupy low, partially wooded sites. The wetlands appear to have been contiguous before roads were built in the area (U.S.G.S. quadrangle map, Kingsley, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Topography

Traverse City Area Wetlands #1 and #2 have a total relief of 15 feet, with elevations ranging from 585 to 600 feet above sea level, 5 to 20 feet above the approximate mean elevation of Lake Michigan. Both lie on a narrow lacustrine plain which is adjacent to a hilly morainal plain. The hills have elevations ranging to over 1,000 feet above sea level. The Great Lakes Basin Commission (1975) describes the shoreline near Traverse City Area Wetlands #1 and #2 as an erodible low plain featuring a sand and gravel shoreline.

Surficial Geology

The surficial geology of Traverse City Area Wetlands #1 and #2 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

Two soil types are found in Traverse City Area Wetland #1, Roscommon mucky loamy sand and Rifle peat. The soil type in Traverse City Area Wetland #2 is Kerston muck. Roscommon mucky loamy sand is poorly drained and consists of a layer of loamy sand covered with an undisturbed layer of muck and underlain by sand. Rifle peat consists of black muck underlain with very dark brown peat. This soil developed from woody plant materials and may have layers of undecomposed peat at a depth of more than 18 inches. Rifle peat is a very poorly drained organic soil generally found in level or depressional areas. Kerston muck consists of alternating layers of mineral and organic material. The mineral material includes clay, silt loam, loam, sand, and gravel, and the organic material consists of peat and muck or peaty muck. Kerston muck is a very wet soil generally found on flood plains (Weber et al., 1966).

Hydrology

An unnamed perennial stream flows into Traverse City Area Wetland #1. This short stream originates south of the wetland in the adjacent hills. In addition, a small unnamed stream flows along the northwestern edge of Traverse City Wetland #1.

An unnamed stream flows northwest through the center of Traverse City Wetland #2. This stream originates in a wetland south of Traverse City Area Wetland #2 and has an elevational change of approximately 10 feet as it flows through Traverse City Area Wetland #2 (U.S.G.S. quadrangle map, Kingsley, Michigan, 1956).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Traverse City Area Wetlands #1 and #2.

Climate

The closest weather station providing climatic data for Traverse City Area Wetlands #1 and #2 is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Traverse City Area Wetlands #1 and #2 (U.S.G.S. quadrangle map, Kingsley, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973).

BIOTIC SETTING

LM 027-028

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Traverse City Area Wetlands #1 and #2.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019).

Some of these species may occur in Traverse City Area Wetlands #1 and #2. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Traverse City Area Wetlands #1 and #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Traverse City Area Wetlands #1 and #2.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Traverse City Area Wetlands #1 and #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Traverse City Area Wetlands #1 and #2 lie within the Traverse City Christmas Bird Count census area. Table 2-16 presents a summary of species observed during the 1972-1976 counts, and provides an indication of the winter bird population that may be present in the two wetlands. It should be noted, however, that the Traverse City Area Wetland Complex comprises only a small portion of the Traverse City Christmas Bird Count census area. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland complex.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Traverse City Area Wetlands #1 and #2.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Traverse City Area Wetland Complex by the literature search.

Table 2-16. Summary of the 1972-76 Traverse
City Christmas Bird Counts^a

Species	1976	1975	1974	1973	1972
common loon	3	--	2	--	2
horned grebe	40	8	2	--	4
mute swan	414	325	258	600	364
whistling swan	16	15	15	16	11
Canada goose	8	4	--	1	--
mallard	1417	820	743	307	343
black duck	163	198	225	74	175
ring-necked duck	1	1	1	1	--
scaup spp.	401	104	30	92	182
common goldeneye	191	102	70	168	168
bufflehead	81	48	49	48	51
hooded merganser	2	4	5	6	4
common merganser	56	72	10	84	318
red-breasted merganser	5	1	--	4	4
red-shouldered hawk	--	--	--	--	1
sharp-shinned hawk	2	1	1	--	3
American coot	15	11	16	4	3
common snipe	6	1	1	1	1
herring gull	56	62	1461	600	368
ring-billed gull	145	286	1287	785	410
screech owl	3	1	1	--	--
belted kingfisher	1	--	1	--	2
pileated woodpecker	1	--	1	1	1
red-winged blackbird	--	1	2	4	--

^aArbib (1973, 1974, 1975, 1976, 1977)

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland complex.

CULTURAL SETTING

LM 027-028

Population

Traverse City Area Wetlands #1 and #2 are located in close proximity to Traverse City in Grand Traverse County, Michigan. The county is sparsely populated, having a density of 85 persons per square mile. Table 2-17 indicates that Grand Traverse County and Traverse City both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Grand Traverse County is expected to undergo continued rapid population growth.

Table 2-17. Population Data for the Vicinity of Traverse City Area Wetlands #1 and #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Grand Traverse County	44,875	14.6	62,405
Traverse City	19,637	8.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Traverse City Area Wetlands #1 and #2 is rural open space. Residential development to the north and northwest of the wetlands represents the eastward extension of Traverse City; agricultural and other rural open space uses surround the remainder of the complex (Michigan Department of State Highways and Transportation aerial photograph, 1973).

The northern portion of Traverse City Area Wetland #2 lies within Traverse City State Park and is under state ownership; the eastern portion of the wetland extends into a parcel of land owned by Traverse City. Traverse City Area Wetland #1 is under private ownership (Rockford Map Publishers, Inc., 1975).

With the exception of the portion of Traverse City Wetland #2 within the state park, both Traverse City Area Wetlands #1 and #2 may be viewed as having high development pressures due to their close proximity to Traverse City. Under the Coastal Zone Management Plan proposed by the Northwest Regional Planning and Development Commission (1977), much of the area around Traverse City is planned

for "urban area" or "recreational areas." Should these plans be realized, it is possible that the wetlands would be developed for one of these purposes. Traverse City Airport lies less than a mile to the west of Traverse City Area Wetlands #1 and #2. A secondary highway and access roads lie between the wetlands (U.S.G.S. quadrangle map, Kingsley, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973).

Recreation

The northern portion of Traverse City Area Wetland #2 extends into Traverse City State Park. The most prominent feature of this 39-acre state park is its beach on Grand Traverse Bay. The park is popular for camping. Other activities available in the park include fishing and picnicking (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Traverse City Area Wetlands #1 and #2 lie within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). A cluster of four active sand and gravel operations are present approximately one mile south of Traverse City Area Wetland #1 (Michigan Department of State Highways and Transportation aerial photograph, 1973).

Traverse City Area Wetlands #1 and #2 are located on the northern edge of an area considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975). No coal resources are present near the wetlands (Smith, 1915).

Traverse City Area Wetlands #1 and #2 are partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether these wooded areas are used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Traverse City Area Wetlands #1 and #2 (U.S.G.S. quadrangle map, Kingsley, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Traverse City Area Wetland #1 (Michigan Water Quality Division, 1978). The Parson Corporation holds an NPDES permit for discharge into Mitchell Creek, situated west of Traverse City Area Wetland #2. The effect of the discharge (if any) by the Parson Corporation on Traverse City Area Wetland #2 is not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Traverse City Area Wetlands #1 and #2 (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that four archaeological sites are present in the vicinity of the wetlands. Sites 20-GT-32, 20-GT-33, 20-FT-34, and 20-GT-35 are mounds of an unknown culture and time period (Peebles and Black, 1976). Further information regarding the field research and exact location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 027-028

The literature search identified no on-going or impending research projects pertaining to the Traverse City Area Wetland Complex.

PENINSULA TOWNSHIP WETLAND #1

LM 029

According to the U.S.G.S. quadrangle map for Elk Rapids, Michigan (1957), Peninsula Township Wetland #1 is located on the western shoreline of the East Arm of Grand Traverse Bay in Grand Traverse County, Michigan. A recent survey by aerial photography, however, has shown that the wetland has been drained, probably for use as an orchard (Michigan Department of State Highways and Transportation aerial photograph, 1973), so it will receive no further consideration in this study.

PENINSULA TOWNSHIP AREA WETLAND COMPLEX

LM 030-031

The Peninsula Township Area Wetland Complex is comprised of Peninsula Township Wetlands #2 and #3. These wetlands appear on the U.S.G.S. quadrangle map for Elk Rapids, Michigan (1957) on the western shoreline of the East Arm of Grand Traverse Bay, in Grand Traverse County. However, a recent survey by aerial photography has shown that both wetlands have been drained, probably for use as orchards (Michigan Department of State Highways and Transportation aerial photograph, 1973), so they will receive no further consideration in this study.

BOWERS HARBOR WETLAND

PHYSIOGRAPHIC SETTING

LM 032

Setting

Bowers Harbor Wetland is located 0.2 mile inland from the eastern shoreline of the West Arm of Grand Traverse Bay, in Grand Traverse County, Michigan, at the head of Bowers Harbor and 9.5 miles northeast of Traverse City. A series of coastal beach ridges parallels the shoreline of Bowers Harbor; the wetland lies within and behind these beach ridges. It is a Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Bowers Harbor Wetland is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a lacustrine plain which forms a narrow peninsula separating the East and West Arms of Grand Traverse Bay. The shoreline near the wetland is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Bowers Harbor Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Bowers Harbor Wetland is Lupton muck, which consists of a deep layer of black muck over mineral material. This soil formed from decomposed woody plants but is more completely decomposed than other organic soils. Lupton muck is very poorly drained (Weber et al., 1966).

Hydrology

There are no streams flowing through Bowers Harbor Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957), but a small pond lies near its center. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Bowers Harbor Wetland.

Climate

The closest weather station providing climatic data for Bowers Harbor Wetland is located in Traverse City, Michigan. In 1975, the average monthly

temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Bowers Harbor is formed by Neah-Ta-Wanta Point, a bay side bar (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 032

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Bowers Harbor Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Bowers Harbor Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Bowers Harbor Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Bowers Harbor Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Bowers Harbor Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-2, D-4, and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Bowers Harbor Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Bowers Harbor Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Bowers Harbor Wetland by the literature search. However, an abandoned eagle's nest has been reported on nearby Marion Island by the Michigan Department on Natural Resources (Michigan Shorelands Management Unit, 1975).

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 032

Population

Bowers Harbor Wetland is located in Peninsula Township of Grand Traverse County, Michigan. The county is sparsely populated, having a density of 85 persons per square mile. Table 2-18 indicates that Grand Traverse County and Peninsula Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Grand Traverse County is expected to undergo continued rapid population growth.

Table 2-18. Population Data for the Vicinity of Bowers Harbor Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Grand Traverse County	44,875	14.6	62,405
Peninsula Township	3,201	21.2	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Bowers Harbor Wetland is rural open space. The surrounding area is characterized by agricultural and other rural open space uses, primarily in the form of orchards, with shoreline residential development along Bowers Harbor. Much of the area surrounding Bowers Harbor Wetland is in orchards. A secondary highway lies lakeward of the wetland, and an access road lies to the west (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Bowers Harbor Wetland.

Mineral, Energy, and Forest Resources

Bowers Harbor Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey Division, 1977; Smith, 1915).

Bowers Harbor Wetland is partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Bowers Harbor Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Bowers Harbor Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Bowers Harbor Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 032

The literature search identified no on-going or impending research projects pertaining to Bowers Harbor Wetland.

LEE POINT WETLAND

PHYSIOGRAPHIC SETTING

LM 033

Setting

Lee Point Wetland is located 0.2 mile inland from the western shoreline of the West Arm of Grand Traverse Bay, in Leelanau County, Michigan, 3.5 miles southeast of the community of Suttons Bay. The wetland lies behind Lee Point, a cusped bay side bar, and coastal beach ridges lie within and adjacent to it. Lee Point Wetland is a Lacustrine System and occupies a low, heavily wooded site (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Lee Point Wetland is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain located lakeward of a hilly morainal area. Inland elevations range to over 800 feet above sea level. The Great Lakes Basin Commission (1975) describes the shoreline near Lee Point Wetland as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Lee Point Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

Two soil types are found in Lee Point Wetland: Lupton-Markey muck and Roscommon sand-Markey muck. Markey muck and Lupton muck have a surface layer of black muck and are underlain by sand and mucky peat. These organic soils are very poorly drained and have very slow to ponded surface runoff. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Weber et al., 1973).

Hydrology

There are no streams flowing through Lee Point Wetland, but a small pond lies within its northern boundary (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Lee Point Wetland.

Climate

The closest weather station providing climatic data for Lee Point Wetland is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Lee Point Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems application Center, aerial reconnaissance, 1978).

BIOTIC SETTING

LM 033

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Lee Point Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Lee Point Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Lee Point Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Lee Point Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Lee Point Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life

histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4, and D-5 contains general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Lee Point Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Species which may utilize Lee Point Wetland are listed in Appendix E-1. The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Lee Point Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 033

Population

Lee Point Wetland is located in Bingham Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 2-19 indicates that Leelanau County and Bingham Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 2-19. Population Data for the Vicinity of Lee Point Wetland

	Estimated population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected population 1990 ^b
Leelanau County	12,527	15.2	16,908
Bingham Township	968	5.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Lee Point Wetland is rural open space. The surrounding area is primarily in rural open space, with some agricultural open space (orchards) to the north and to the west, and some residential development along the shoreline of the West Arm of Grand Traverse Bay. An access road lies lakeward of Lee Point Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership and is immediately adjacent to property owned by Lees Point Resort (Rockford Map Publishers, Inc., 1975); its location suggests that it is subject to moderate development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Lee Point Wetland.

Mineral, Energy, and Forest Resources

Lee Point Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey Division, 1977; Smith, 1915).

Lee Point Wetland is heavily wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Lee Point Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Lee Point Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Lee Point Wetland, (Pebbles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that one archaeological site (20-LU-55, representing a habitation of unknown culture and date) is present in the vicinity of the wetland (Pebbles and Black, 1976). Further information regarding the field research and exact location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 033

The literature search identified no on-going or impending research projects pertaining to Lee Point Wetland.

SUTTONS BAY WETLAND

PHYSIOGRAPHIC SETTING

LM 034

Setting

Suttons Bay Wetland is located 0.2 mile inland from the western shoreline of the West Arm of Grand Traverse Bay, in Leelanau County, Michigan, 1.2 miles southeast of the community of Suttons Bay. Portions of the wetland have been cleared of vegetation and drained for agricultural and residential use. The remaining portion is heavily wooded. Suttons Bay Wetland is a Palustrine System and occupies a raised site (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Suttons Bay Wetland is 20 feet; wetland elevations range from 600 to 620 feet above sea level, 20 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a lacustrine plain located lakeward of a hilly morainal area. Inland elevations range to over 900 feet above sea level. The shoreline near Suttons Bay Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Suttons Bay Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The eastern portion of Suttons Bay Wetland contains Lupton-Markey muck and the western part contains Roscommon sand-Markey muck. Markey muck and Lupton muck have a surface layer of black muck underlain by sand and mucky peat. These organic soils are very poorly drained and have very slow to ponded surface runoff. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Weber et al., 1973).

Hydrology

There are no streams flowing through Suttons Bay Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Suttons Bay Wetland.

Climate

The closest weather station providing climatic data for Suttons Bay Wetland is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Suttons Bay Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 034

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Suttons Bay Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Suttons Bay Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Suttons Bay Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Suttons Bay Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Suttons Bay Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal

distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4, and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Suttons Bay Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Species which may utilize Suttons Bay Wetland are listed in Appendix E-1. The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Suttons Bay Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, a settling pond is located in the vicinity of the wetland, which may have some affect on its health.

CULTURAL SETTING

LM 034

Population

Suttons Bay Wetland is located in Suttons Bay Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 2-20 indicates that Leelanau County and Suttons Bay Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 2-20. Population Data for the Vicinity of Suttons Bay Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Suttons Bay Township	1,665	22.4	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Suttons Bay Wetland is rural open space. The surrounding area is a mixture of agricultural open space (orchards) and other rural open space uses. Limited residential development is primarily concentrated around Suttons Bay. A secondary highway lies lakeward of the wetland, separating it from Grand Traverse Bay, and another highway runs directly through the wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate to high development pressures. However, it should be noted that the Suttons Bay waterfront has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be accepted, portions of Suttons Bay Wetland may fall within an area to be preserved in a natural state.

Recreation

There are no known state or federal recreational facilities in the vicinity of Suttons Bay Wetland.

Mineral, Energy, and Forest Resources

Suttons Bay Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Suttons Bay Wetland is heavily wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Suttons Bay Wetland (U.S.G.S. quadrangle map, Traverse City, Michigan, 1957).

Pollution Sources

A settling pond is situated west of Suttons Bay Wetland (Michigan State Department of Highways and Transportation aerial photograph, 1973). It is not known whether any discharge is released from the pond. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Suttons Bay Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 034

The literature search identified no on-going or impending research projects pertaining to Suttons Bay Wetland.

OMENA WETLAND

PHYSIOGRAPHIC SETTING

LM 035

Setting

Omena Wetland is located 0.1 mile inland from the western shoreline of Grand Traverse Bay, in Leelanau County, Michigan, west of the head of New Mission Bay and 0.1 mile west of the community of Omena. The wetland is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Omena Wetland is very slight; wetland elevations range from approximately 638 to 640 feet above sea level, 58 to 60 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a narrow lacustrine plain located lakeward of a till plain. Drumlins are common near the wetland. The shoreline near Omena Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Omena Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Omena Wetland is Mancelona-East Lake loamy sand, which is a moderately well drained, sandy soil with a surface layer of very dark grayish-brown loamy sand underlain with coarse sand and gravel. Mancelona-East Lake loamy sand has low natural fertility and low available water capacity, and is generally found on outwash plains (Weber et al., 1973).

Hydrology

There are no streams flowing through Omena Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Omena Wetland.

Climate

The closest weather station providing climatic data for Omena Wetland is located in Traverse City, Michigan. In 1975, the average monthly temperature was 46.8°F, the average daily low for January was 18.1°F and the average daily high in July was 83.4°F. The average annual precipitation is 29.89 inches, with

a mean monthly precipitation of 1.81 inches in January and 3.02 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on May 13 and the first killing frost on November 13 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Omena Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 035

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Omena Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Omena Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Omena Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Omena Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Omena Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Gelston (1970, 1971, 1972), a pair of mute swans (Cygnus olor) nested in the vicinity of Omena Wetland in 1969, 1970, and 1971. The nests were built on top of a muskrat house. Only in 1970 did young reach fledgling stage, because production in other years was affected by high water levels and storms.

Appendices D-4, and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Omena Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Species which may utilize Omena Wetland are listed in Appendix E-1. The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Omena Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 035

Population

Omena Wetland is located in Leelanau Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 2-21 indicates that Leelanau County and Leelanau Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 2-21. Population Data for the Vicinity of Omena Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Leelanau Township	1,441	13.5	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Omena Wetland is primarily rural open space; however, a rail line runs through the wetland. The area surrounding Omena Wetland is a mixture of agricultural open space (orchards) and other rural open space uses except for residential development (the community of Omena) along New Mission Bay. A secondary highway lies between the wetland and the lakeshore, and the Chesapeake and Ohio rail line runs directly through the wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate to high development pressures. However, it should be noted that Omena Bay has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program. Should the nomination be accepted, the bay area in which the wetland is located would be protected (Northwest Michigan Regional Planning and Development Commission, 1977).

Recreation

There are no known state or federal recreational facilities in the vicinity of Omena Wetland.

Mineral, Energy, and Forest Resources

Omena Wetland lies within an area of Silurian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Omena Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Omena Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Omena Wetland (Michigan State Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Omena Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 035

The literature search identified no on-going or impending research projects pertaining to Omena Wetland.

ENNIS CREEK AREA WETLAND

PHYSIOGRAPHIC SETTING

LM 036

Setting

Ennis Creek Area Wetland is located 0.2 mile inland from the western shoreline of Grand Traverse Bay, in Leelanau County, Michigan, 1.2 miles south of the community of Northport. Ennis Creek flows into the bay 0.3 mile south of the wetland. Ennis Creek Area Wetland is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Ennis Creek Area Wetland is 10 feet; wetland elevations range from 610 to 620 feet above sea level, 30 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a till plain which slopes gently towards Lake Michigan. Inland topography is hilly, and drumlins are common in the area. The shoreline near Ennis Creek Area Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Ennis Creek Area Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are two soil types found in Ennis Creek Area Wetland: Lupton-Markey muck and Roscommon sand-Markey muck. Markey muck and Lupton muck have a surface layer of black muck underlain by sand and mucky peat. These organic soils are very poorly drained and have very slow to ponded surface runoff. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Weber et al., 1973).

Hydrology

There are no streams flowing through Ennis Creek Area Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Ennis Creek Area Wetland.

Climate

The closest weather station providing climatic data for Ennis Creek Area Wetland is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Ennis Creek Area Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 036

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Ennis Creek Area Wetland.

Fish

Species expected to be associated with wetlands along Grand Traverse Bay are listed in connection with the Banks Township Wetland Complex (LM 017-019). Some of these species may occur in Ennis Creek Area Wetland. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Ennis Creek Area Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Ennis Creek Area Wetland.

Reptiles and Amphibians

Appendix C-2 contains general information on the amphibians and reptiles of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Ennis Creek Area Wetland. The literature search yielded no site-specific information pertaining to major species,

seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-4 and D-5 contain general information on the wetland birds of Lake Section 2, but care should be exercised in the interpretation of the relevance of this information to Ennis Creek area Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Species which may utilize Ennis Creek Area Wetland are listed in Appendix E-1. The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Ennis Creek Area Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, a settling pond is located in the vicinity of the wetland, which may have some affect on its health.

CULTURAL SETTING

LM 036

Population

Ennis Creek Area Wetland is located in Leelanau Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 2-22 indicates that Leelanau County and Leelanau Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 2-22. Population Data for the Vicinity of Ennis Creek Area Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Leelanau Township	1,441	13.5	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Ennis Creek Area Wetland is rural open space. The surrounding area is predominantly in agricultural open space uses (primarily orchards) inland from the wetland, but the Indiana Beach Resort development lies between the wetland and Northport Bay. Roads and a rail line surround Ennis Creek Area Wetland on three sides (U.S.G.S. quadrangle map, Northport, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate to high development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Ennis Creek Area Wetland.

Mineral, Energy, and Forest Resources

Ennis Creek Area Wetland lies within an area of Silurian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Ennis Creek Area Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Ennis Creek Area Wetland (U.S.G.S. quadrangle map, Northport, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Ennis Creek Area Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Ennis Creek Area Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 036

The literature search identified no on-going or impending research projects pertaining to Ennis Creek Area Wetland.

Table 2-23 . Data Gaps - Lake Section 2

Data Gap*		Wetland Number	013	014	015	016	017-019	020	021	022	023	024	025	026	027-028	032	033	034	035	036	
Physiographic Setting	Setting																				
	Topography																				
	Surficial Geology																				
	Soils																				
	Hydrology	Water Level Fluctuations		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Groundwater		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Water Quality		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Depth		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Changes		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Climate																			
Special Features																					
Biotic Setting	Vegetation	Major Species Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Major Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Fish	Major species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Spawning and Hatching Areas	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Commercial/Recreational Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Invertebrates	Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Amphibians/Reptiles	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Life Histories		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Avifauna	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Mammals	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Cultural Setting	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Endangered Species																				
	Health	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Population																				
	Land Use and Ownership																				
	Recreation																				
Cultural Setting	Mineral, Energy, Forest Resource																				
	Public Utilities/Facilities																				
	Point Pollution Sources																				
	Non-Point Pollution Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Historic Features																				
Archaeologic Features				*			*	*	*	*	*	*	*	*	*	*	*	*			

LAKE SECTION 3

INTRODUCTION

Lake Section 3 extends along the eastern shoreline of Lake Michigan from Cathead Point at the tip of Leelanau Peninsula to Lookout Point, north of Portage Lake. The lake section also encompasses a series of islands situated in eastern Lake Michigan. These include Beaver Island, North Manitou Island, Gull Island, High Island, Hog Island, and Garden Island. Beaver Island is the most prominent, with a surface area of 58 square miles.

The wetlands of Lake Section 3 are situated within Leelanau, Charlevoix, Benzie, and Manitou Counties in Michigan, all of which are sparsely populated. Most of the wetlands lie on a low lacustrine plain, although several are on a hilly morainal plain. Predominant shore types in the vicinity of the wetlands are erodible low plain and erodible low bluff (Great Lakes Basin Commission, 1975).

Figures 3-1 and 3-2 show the approximate location of the 39 wetlands in Lake Section 3. Latitude, longitude, acreage, and classification for each of the wetlands are presented in Table 3-1. Elevations of these wetlands range from 580 to 730 feet above sea level (lake level to 150 feet above the approximate mean elevation of Lake Michigan). Most of the wetlands are either Palustrine or Lacustrine Systems, but several Riverine Systems are also included.

Information related to the physiographic and cultural features of the wetlands in Lake Section 3 is summarized in the individual wetland narratives presented in this chapter. Site-specific biotic data are available in published sources only for Betsie River Wetland and Arcadia Lake Wetland.

LAKE MICHIGAN

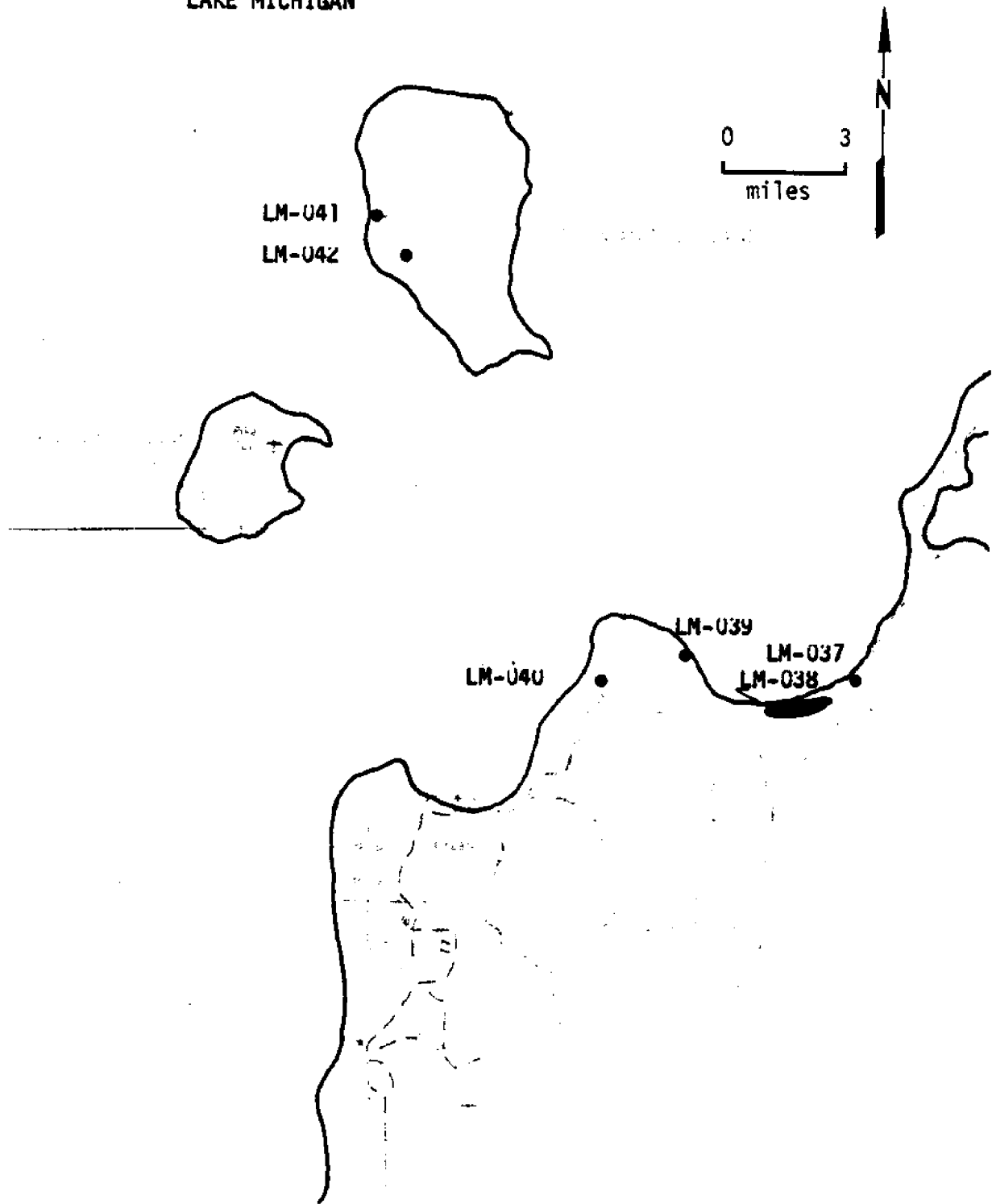


Figure 3-1. Lake Section 3 - Manitou Island Area
-164-

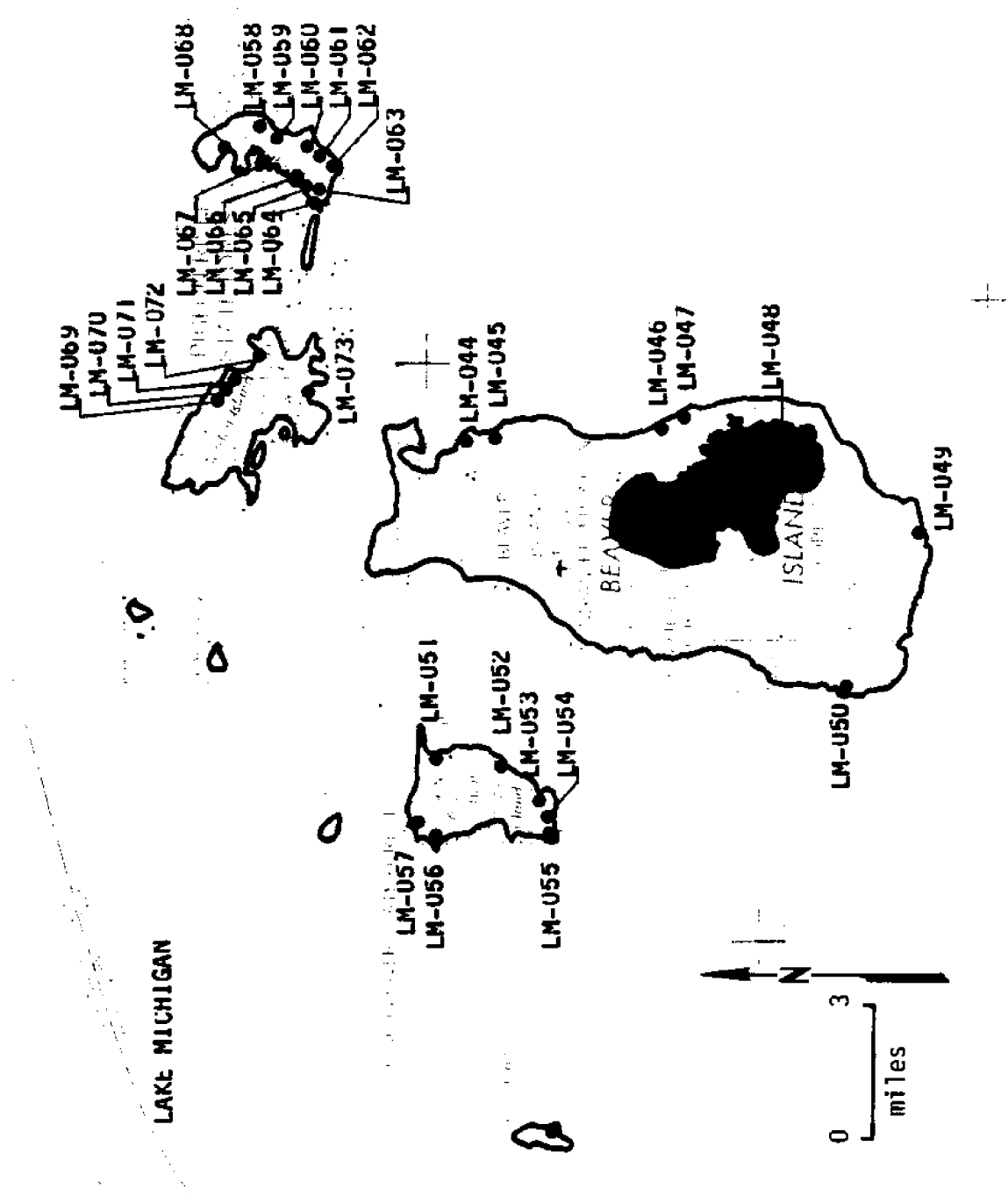


Figure 3-2. Lake Section 3 - Beaver Island Area
-165-

Table 3-1. Location, Acreage, and Classification of Wetlands
in Lake Section 3

Wetland Number	Wetland	Latitude	Longitude	Acreage	Classification ^a
037	Good Harbor Bay Wetland #1	45°56'42"	85°48'20"	88	P
038	Good Harbor Bay Wetland #2	45°56'10"	85°49'40"	165	P
039	Good Harbor Bay Wetland #3	45°57'00"	85°53'30"	39	L
040	Port Oneida Wetland	45°56'40"	85°56'00"	272	P
	NORTH MANITOU ISLAND WETLAND COMPLEX				
041	Leland Township Wetland	45°06'50"	86°03'17"	10	P
042	Tamarack Lake Wetland	45°05'53"	86°04'25"	58	P
043	Gull Island Wetland	45°41'49"	85°50'15"	10	L
	BEAVER ISLAND WETLAND COMPLEX (NORTH)				
044	Looney Point Wetland	45°43'35"	85°30'02"	19	L
045	Little Sandy Bay Wetland	45°42'50"	85°29'50"	58	L
	BEAVER ISLAND WETLAND COMPLEX (SOUTH)				
046	Jordan River Wetland	45°39'03"	85°30'10"	68	R
047	Point La Par Wetland	45°38'40"	85°29'55"	146	P
048	Beaver Island Interior Wetland	45°37'50"	85°30'50"	3325	P
049	Kelly Point Area Wetland	45°34'35"	85°33'20"	117	P
050	French Bay Wetland	45°31'00"	85°37'20"	39	L
	HIGH ISLAND WETLAND COMPLEX				
051	High Island Wetland #1	45°44'25"	85°39'33"	10	P
052	High Island Wetland #2	45°43'00"	85°39'33"	10	P
053	High Island Wetland #3	45°42'20"	85°40'13"	12	P
054	High Island Wetland #4	45°41'52"	85°41'00"	10	L
055	High Island Wetland #5	45°41'50"	85°41'40"	10	L
056	High Island Wetland #6	45°44'22"	85°41'40"	15	L
057	High Island Wetland #7	45°44'48"	85°41'20"	10	L
	HOG ISLAND WETLAND COMPLEX				
058	Hog Island Wetland #1	45°47'30"	85°21'35"	19	P
059	Hog Island Wetland #2	45°47'16"	85°21'38"	19	P
060	Hog Island Wetland #3	45°46'31"	85°22'10"	10	P
061	Hog Island Wetland #4	45°46'25"	85°22'12"	10	L
062	Hog Island Wetland #5	45°46'15"	85°22'32"	39	L
063	Hog Island Wetland #6	45°46'33"	85°23'05"	10	L
064	Hog Island Wetland #7	45°46'32"	85°23'25"	30	P
065	Hog Island Wetland #8	45°47'03"	85°23'02"	19	L
066	Hog Island Wetland #9	45°47'10"	85°22'50"	10	L
067	Hog Island Wetland #10	45°47'35"	85°22'28"	97	L
068	Hog Island Wetland #11	45°48'15"	85°21'55"	39	P
	GARDEN ISLAND WETLAND COMPLEX				
069	Garden Island Wetland #1	45°48'55"	85°29'40"	10	P
070	Garden Island Wetland #2	45°48'52"	85°29'30"	10	P
071	Garden Island Wetland #3	45°48'30"	85°28'50"	10	P
072	Jensen Harbor Wetland	45°47'25"	85°28'15"	39	L
073	Northcutt Bay Wetland	45°46'50"	85°28'50"	29	L
074	Betsie River Wetland	44°36'35"	86°12'25"	380	R
075	Arcadia Lake Wetland	44°29'20"	86°13'30"	360	L,R

^aP=palustrine
L=lacustrine
R=riverine

GOOD HARBOR BAY WETLAND #1

PHYSIOGRAPHIC SETTING

LM 037

Setting

Good Harbor Bay Wetland #1 is located 0.7 mile inland from Good Harbor Bay on the eastern shoreline of Lake Michigan in Leelanau County, Michigan, 5.6 miles southwest of the community of Leland. Coastal beach ridges parallel most of the shoreline of Good Harbor Bay, and the wetland lies at the eastern end of this beach ridge complex. Blowouts are located near the wetland. Good Harbor Bay Wetland #1 is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Good Harbor Bay Wetland #1 is very slight; wetland elevations range from approximately 597 to 600 feet above sea level, 17 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a lacustrine plain located lakeward of a hilly morainal area. Inland elevations range to over 1,000 feet above sea level; drumlins and small lakes are common in the area. The shoreline near Good Harbor Bay Wetland #1 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Good Harbor Bay Wetland #1 is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Good Harbor Bay Wetland #1 is Kalkaska-East Lake loamy sand, which has a loamy sand surface layer containing organic matter, underlain by dark brown to reddish-brown loamy sand. This soil has low natural fertility, low available water capacity, and slow surface runoff. Kalkaska-East Lake loamy sand is generally found in valleys and beach ridges (Weber et al., 1973).

Hydrology

There are no streams flowing through Good Harbor Bay Wetland #1 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Good Harbor Bay Wetland #1.

Climate

The closest weather station providing climatic data for Good Harbor Bay Wetland #1 is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Good Harbor Bay Wetland #1 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

BIOTIC SETTING

LM 037

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Good Harbor Bay Wetland #1.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Good Harbor Bay Wetland #1.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Good Harbor Bay Wetland #1.

Reptiles and Amphibians

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Good Harbor Bay Wetland #1. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Good Harbor Bay Wetland #1.

Mammals

Mammalian species which may utilize Good Harbor Bay Wetland #1 are listed in Appendix E-1.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Good Harbor Bay Wetland #1.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Good Harbor Bay Wetland #1 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 037

Population

Good Harbor Bay Wetland #1 is located in Centerville Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 3-2 indicates that Leelanau County and Centerville Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 3-2. Population Data for the Vicinity of Good Harbor Bay Wetland #1

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Centerville Township	524	10.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Good Harbor Bay Wetland #1 is rural open space. The surrounding area is in agricultural and other rural open space uses. An access road lies near Good Harbor Bay Wetland #1, and a cemetery lies to the east (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland lies within the Sleeping Bear Dunes National Lakeshore and is under federal ownership (Rockford Map Publishers, Inc., 1975), so development pressures are assumed to be low.

Recreation

There are no known state or federal recreational facilities in the vicinity of Good Harbor Bay Wetland #1.

Mineral, Energy, and Forest Resources

Good Harbor Bay Wetland #1 lies within an area of Silurian salt deposits. However, there are no operations in the area exploiting these resources (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey Division, 1977).

Good Harbor Bay Wetland #1 is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it is unlikely that this wooded area would be used for commercial production since it lies within the Sleeping Bear Dunes National Lakeshore.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Good Harbor Bay Wetland #1 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Good Harbor Bay Wetland #1 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Good Harbor Bay Wetland #1, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 037

The literature search identified no on-going or impending research projects pertaining to Good Harbor Bay Wetland #1.

GOOD HARBOR BAY WETLAND #2

PHYSIOGRAPHIC SETTING

LM 038

Setting

Good Harbor Bay Wetland #2 is located 0.1 mile inland from Good Harbor Bay on the eastern shoreline of Lake Michigan in Leelanau County, Michigan, 5.3 miles north of Maple City. Coastal beach ridges parallel most of the shoreline of Good Harbor Bay, and the wetland lies among these ridges. Blowouts are located along the shoreline near Good Harbor Bay Wetland #2, and Little Traverse Lake lies to the south. The western portion of the wetland lies within Fife Lake State Forest. Good Harbor Bay Wetland #2 is a Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Maple City Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Good Harbor Bay Wetland #2 is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a lacustrine plain located lakeward of a hilly morainal area. Inland elevations range to more than 1,000 feet above sea level; drumlins and small lakes are common in the area. The shoreline near Good Harbor Bay Wetland #2 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Good Harbor Bay Wetland #2 is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Good Harbor Bay Wetland #2 is Roscommon sand-Markey muck. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Markey muck, an organic soil comprising 30% of the mapped soil, is underlain with brown sand. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Weber et al., 1973).

Hydrology

There are no streams flowing through Good Harbor Bay Wetland #2 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Good Harbor Bay Wetland #2.

Climate

The closest weather station providing climatic data for Good Harbor Bay Wetland #2 is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Good Harbor Bay Wetland #2 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

BIOTIC SETTING

LM 038

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Good Harbor Bay Wetland #2.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Good Harbor Bay Wetland #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Good Harbor Bay Wetland #2.

Reptiles and Amphibians

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Good Harbor Bay Wetland #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Good Harbor Bay Wetland #2.

Mammals

Mammalian species which may utilize Good Harbor Bay Wetland #2 are listed in Appendix E-1.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Good Harbor Bay Wetland #2 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 038

Population

Good Harbor Bay Wetland #2 is located in Cleveland Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 3-3 indicates that Leelanau County and Cleveland Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 3-3. Population Data for the Vicinity of Good Harbor Bay Wetland #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Cleveland Township	482	22.6	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Good Harbor Bay Wetland #2 is rural open space. The surrounding area is primarily rural open space, with agricultural open space to the east and limited shoreline residential development along Good Harbor Bay. An access road crosses Good Harbor Bay Wetland #2 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland lies within the Sleeping Bear Dunes National Lakeshore and is under mixed private, state, and federal ownership (Rockford Map Publishers, Inc., 1975). Its location suggests that it is under minimal development pressure.

Recreation

The western portion of Good Harbor Bay Wetland #2 lies within the Fife Lake State Forest. Although there are no known areas specifically designated for recreational use in or near the wetland, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

Good Harbor Bay Wetland #2 lies within an area underlain by Silurian salt deposits. However, there are no operations in the area exploiting this resource (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey Division, 1977; Smith, 1915).

Portions of Good Harbor Bay Wetland #2 are wooded and lie within Fife Lake State Forest. State forest lands in the coastal area are within a "water influence zone" in which water quality, water use, and aesthetic surroundings are the principal management concerns. Cover treatments are designed to maintain or enhance these concerns, and timber harvesting within the area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Good Harbor Bay Wetland #2 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Good Harbor Bay Wetland #2 (Michigan Water Quality Division, 1978). No site specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Good Harbor Bay Wetland #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 038

The literature search identified no on-going or impending research projects pertaining to Good Harbor Bay Wetland #2.

GOOD HARBOR BAY WETLAND #3

PHYSIOGRAPHIC SETTING

LM 039

Setting

Good Harbor Bay Wetland #3 is located 0.1 mile inland from Good Harbor Bay on the eastern shoreline of Lake Michigan in Leelanau County, Michigan, 6.5 miles northwest of Maple City. A steep bluffline and Shell Lake lie inland of Good Harbor Bay Wetland #3, and Shaldo Creek flows into Lake Michigan 0.25 mile to the south. Good Harbor Bay Wetland #3 is a Lacustrine System and occupies a low, heavily wooded site (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Good Harbor Bay Wetland #3 is 5 feet; wetland elevations range from 585 to 590 feet above sea level, 5 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a narrow lacustrine plain located lakeward of a hilly morainal area. Inland elevations range to more than 1,000 feet above sea level; drumlins and small lakes are common in the area. The shoreline near Good Harbor Bay Wetland #3 is described by the Great Lakes Basin Commission (1975) as an erodible low plain featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Good Harbor Bay Wetland #3 is characterized by sand dunes (Martin, 1957).

Soils

The soil type in Good Harbor Bay Wetland #3 is Eastport sand, which consists of black sand and grayish-brown sand underlain with dark brown sand and some gravel. This soil has low available water capacity, low natural fertility, and slow surface runoff. Eastport sand is generally found on beach ridges and low sand dunes (Weber et al., 1973).

Hydrology

There are no streams flowing through Good Harbor Bay Wetland #3 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Good Harbor Bay Wetland #3.

Climate

The closest weather station providing climatic data for Good Harbor Bay Wetland #3 is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Pyramid Point, which forms the western extent of Good Harbor Bay, lies roughly two miles to the northwest, and Pyramid Point Shoal lies offshore from the point (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 039

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Good Harbor Bay Wetland #3.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Good Harbor Bay Wetland #3.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Good Harbor Bay Wetland #3.

Reptiles and Amphibians

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Good Harbor Bay Wetland #3. The literature

search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Good Harbor Bay Wetland #3.

Mammals

Mammalian species which may utilize Good Harbor Bay Wetland #3 are listed in Appendix E-1.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Good Harbor Bay Wetland #3.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Good Harbor Bay Wetland #3 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 039

Population

Good Harbor Bay Wetland #3 is located in Cleveland Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 3-4 indicates that Leelanau County and Cleveland Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 3-4. Population Data for the Vicinity of Good Harbor Bay Wetland #3

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Cleveland Township	482	22.6	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Good Harbor Bay Wetland #3 is rural open space. The surrounding area is primarily in rural open space uses, with limited shoreline residential development along Good Harbor Bay. An access road lies adjacent to Good Harbor Bay Wetland #3, and Shell Lake lies to the west of the wetland (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to low to moderate development pressure.

Recreation

There are no known state or federal recreational facilities in Good Harbor Bay Wetland #3.

Mineral, Energy, and Forest Resources

Good Harbor Bay Wetland #3 lies within an area underlain by Silurian salt deposits. However, there are no operations in the area exploiting this resource (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Good Harbor Bay Wetland #3 is heavily wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Good Harbor Bay Wetland #3 (U.S.G.S. quadrangle map, Maple City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Good Harbor Bay Wetland #3 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Good Harbor Bay Wetland #3, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 039

The literature search identified no on-going or impending research projects pertaining to Good Harbor Bay Wetland #3.

PORT ONEIDA WETLAND

PHYSIOGRAPHIC SETTING

LM 040

Setting

Port Oneida Wetland is located 0.1 mile from the eastern shoreline of Lake Michigan in Leelanau County, Michigan, 3.7 miles northeast of the community of Glen Arbor. The wetland is a Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Port Oneida Wetland is 10 feet; wetland elevations range from 605 to 615 feet above sea level, 25 to 35 feet above the approximate mean elevation of Lake Michigan. The wetland occupies a relatively small depression in a hilly morainal plain; inland lakes are common nearby. The shoreline near Port Oneida Wetland is described by the Great Lakes Basin Commission (1975) as an erodible bluff featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Port Oneida Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

Two soil types are found in Port Oneida Wetland: Roscommon sand-Markey muck and Lupton-Markey muck. Markey muck and Lupton muck have a surface layer of black muck underlain by sand and mucky peat; these organic soils are very poorly drained and have very slow to ponded surface runoff. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Markey muck, an organic soil which comprises 30% of the mapped soil, is underlain with brown sand. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Weber et al., 1973).

Hydrology

There are no streams flowing through Port Oneida Wetland (U.S.G.S. quadrangle map, Maple City, Michigan, 1957). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Good Harbor Bay Wetland #3.

Climate

The closest weather station providing climatic data for Port Oneida Wetland is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Port Oneida Wetland (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973).

BIOTIC SETTING

LM 040

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Port Oneida Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Port Oneida Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Port Oneida Wetland.

Reptiles and Amphibians

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Port Oneida Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Port Oneida Wetland.

Mammals

Mammalian species which may utilize Port Oneida Wetland are listed in Appendix E-1.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Port Oneida Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 040

Population

Port Oneida Wetland is located in Glen Arbor Township of Leelanau County, Michigan. The county is sparsely populated, having a density of 32 persons per square mile. Table 3-5 indicates that Leelanau County and Glen Arbor Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Leelanau County is expected to undergo continued rapid population growth.

Table 3-5. Population Data for the Vicinity of Port Oneida Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Leelanau County	12,527	15.2	16,908
Glen Arbor Township	736	28.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Port Oneida Wetland is rural open space. The surrounding area is in agricultural open space uses, with limited shoreline residential development (the community of Port Oneida) along Lake Michigan. A secondary highway lies lakeward of Port Oneida Wetland, and there are access roads to the south and east. Small orchards lie at the eastern periphery of the wetland, and a cemetery is a short distance south (U.S.G.S. quadrangle map, Maple City, Michigan, 1957; Michigan Department of State Highways and Transportation aerial photograph, 1973). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests moderate development pressures.

Recreation

There are no known state or federal recreational facilities in Port Oneida Wetland.

Mineral, Energy, and Forest Resources

Port Oneida Wetland lies within an area underlain by Silurian salt deposits. However, there are no operations in the area exploiting this resource (Gere, 1977). No oil, gas, or coal resources are present in the wetland (Michigan Geological Survey Division, 1977; Smith, 1915).

Port Oneida Wetland is partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Port Oneida Wetland (U.S.G.S. quadrangle map, Maple City, Michigan, 1957).

Pollution Sources

There are no NPDES permit holders adjacent to Port Oneida Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Port Oneida Wetland nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 040

The literature search identified no on-going or impending research projects pertaining to Port Oneida Wetland.

NORTH MANITOU ISLAND WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 041-042

Setting

The North Manitou Island Wetland Complex, comprised of Leland Township Wetland and Tamarack Lake Wetland, is located on North Manitou Island in Leelanau County, Michigan. Leland Township Wetland is situated 0.1 mile inland from the western shoreline of the island and 3.7 miles west of the community of North Manitou. A steep bluffline and sand dunes lie along this shoreline; the wetland occupies a small ravine in this bluffline.

Tamarack Lake Wetland is located 0.2 mile inland from the southwestern shoreline of North Manitou Island, 3.0 miles southwest of North Manitou. Tamarack Lake Wetland is behind a bluffline, 30 feet above Lake Michigan. Tamarack Lake is a small pond located at the northeastern end of the wetland, and a quaking bog extends as a shelf into part of Tamarack Lake (Hatt et al., 1948). The area has been given an excellent description by Coulter (1904).

Leland Township Wetland and Tamarack Lake Wetland are Palustrine Systems and occupy raised wooded sites (U.S.G.S. quadrangle map, North Manitou, Michigan 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973). North Manitou Island and South Manitou Island, together with Sleeping Bear Dunes, constitute the Sleeping Bear Dunes National Lakeshore.

Topography

The total relief of Leland Township Wetland is less than 10 feet; wetland elevations range from approximately 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. Tamarack Lake Wetland has elevations ranging from approximately 610 to 640 feet above sea level, 30 to 60 feet above the approximate mean elevation of Lake Michigan; total relief of the wetland is 30 feet. Roughly half of western North Manitou Island is hilly moraine; both wetlands of the complex lie in this area. The island is situated on the southwest-facing slope of the Bois Blanc Formation Cuesta (Hough, 1958).

Surficial Geology

The surficial geology of Leland Township Wetland is characterized by ground moraines. Ground moraine formations, deposited by retreating ice, have little relief and are usually found on plains. These deposits consist of a thin drift cover of till (Martin, 1957; Dorr and Eschman, 1970). The surficial geology of Tamarack Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Leland Township Wetland is Roscommon sand-Markey muck; the soil type in Tamarack Lake Wetland is Lupton-Markey muck. Markey muck and Lupton muck have a surface layer of black muck underlain by sand and mucky peat; these organic soils are very poorly drained and have very slow to ponded surface runoff. The surface layer of Roscommon sand-Markey muck ranges from black sand to muck. Roscommon sand includes some fine gravel at a depth of two feet. Roscommon sand-Markey muck has low natural fertility and low available water capacity (Webster et al., 1973).

Hydrology

There are no streams flowing through either Leland Township Wetland or Tamarack Lake Wetland. However, Tamarack Lake is located in the eastern part of Tamarack Lake Wetland (U.S.G.S. quadrangle map, North Manitou, Michigan, 1956). A small stream feeds Tamarack Lake, and the lake is drained by an intermittent stream which flows for a short distance toward Lake Michigan before disappearing (Hatt et al., 1948).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in the North Manitou Island Wetland Complex.

Climate

The closest weather station providing climatic data for the North Manitou Island Wetland Complex is located in Maple City, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 17.9°F and the average daily high in July was 82.0°F. The average annual precipitation is 35.65 inches, with a mean monthly precipitation of 2.90 inches in January and 3.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

There is a spring east of Leland Township Wetland (U.S.G.S. quadrangle map, North Manitou, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 041-042

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Leland Township Wetland and Tamarack Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Leland Township Wetland and Tamarack Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Leland Township Wetland and Tamarack Lake Wetland.

Reptiles and Amphibians

Hatt et al. (1948) provided general historical information on the amphibians and reptiles observed on North Manitou Island during expeditions in 1937-1944. The species observed at that time are listed in Table 3-6.

Table 3-6. Amphibians and Reptiles Documented on North Manitou Island^a

central newt	northern leopard frog
red-backed salamander	wood frog
American toad	snapping turtle
northern spring peeper	northern ringneck snake
bullfrog	northern ribbon snake
green frog	eastern garter snake

^a Hatt et al. (1948)

Appendices C-3 and C-4 contain general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Leland Township Wetland and Tamarack Lake Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Hatt et al. (1948) provide general historical information on the birds of North Manitou Island. Their list of birds seen on the island includes 76 species, 13 of which were nesting there. An annotated list of birds observed by Hatt et al. appears in Table 3-7. Wood (1951) added the common loon (Garvia

immer), American merganser (Mergus merganser americanus), and sora (Porzana carolina) to the list of species known to breed on North Manitou Island. Scharf et al. (1977) observed a saw-whet owl (Aegolius acadicus) on the island.

Table 3-7. Annotated List of Birds Occurring on North Manitou Island^a

common loon	hairy woodpecker ^b
great blue heron	downy woodpecker ^b
black duck	eastern kingbird ^b
blue-winged teal	great crested flycatcher
bufflehead	least flycatcher ^b
sharp-shinned hawk	tree swallow
Cooper's hawk	bank swallow ^b
red-tailed hawk	barn swallow ^b
bald eagle ^b	purple martin ^b
Virginia rail ^b	common crow ^b
pipit plover ^b	long-billed marsh wren
killdeer ^b	gray catbird
American sandpiper	veery
herring gull	starling ^b
Caspian tern	Nashville warbler ^b
yellow-billed cuckoo	ovenbird ^b
black-billed cuckoo	common yellowthroat
great horned owl	red-winged blackbird ^b
common flicker	purple finch
pileated woodpecker	vesper sparrow ^b
	swamp sparrow

^a Hatt et al. (1948)
^b breeding record

According to Scharf et al. (1977), large numbers of passerine birds and birds of prey move along the shoreline areas of North Manitou Island during migration. This route is considered to be an extension of the South Fox-South Manitou flyway. Information regarding the birds of nearby South Manitou Island is also available in Scharf et al. (1977). However, the literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing the North Manitou Island Wetland Complex.

Mammals

Mammalian species which may utilize the two wetlands of the North Manitou Island Wetland Complex are listed in Table 3-8.

Table 3-8. Mammalian Species of North Manitou Island^a

Common name	Common name
snowshoe hare	deer mouse
red bat	red fox
eastern chipmunk	raccoon
red squirrel	weasel
fox squirrel	white-tailed deer
beaver	

^a Hatt, 1924; Hatt et al., 1928

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting these wetlands.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S.G.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the North Manitou Island Wetland Complex by the literature search. However, the bald eagle (Haliaeetus leucocephalus), which is on the federal list, is known to have nested historically on North Manitou Island (Hatt et al., 1948). Hatt et al. also document the occurrence of the Cooper's hawk (Accipiter cooperii), sharp-shinned hawk (Accipiter striatus), and the Caspian tern (Sterna caspia) on North Manitou Island; the first two are threatened in Michigan, and the others are rare.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

CULTURAL SETTING

LM 041-042

Population

Leland Township Wetland and Tamarack Lake Wetland are located on North Manitou Island. The island at present contains only a small and scattered population, much of which is probably seasonal in nature. Population figures for the island are not readily available.

Land Use and Ownership

Land use within Leland Township and Tamarack Lake Wetlands, as well as in the surrounding area, is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1973). North Manitou Island is part of the Sleeping Bear Dunes National Lakeshore; most of the island, including the wetlands, is under the ownership of the Manitou Island Association. Piles lie offshore from Leland Township Wetland, and an unimproved dirt road lies to the east. There is a trail crossing Tamarack Lake Wetland, and unimproved dirt roads lie on the west and northwest borders (U.S.G.S. quadrangle map, North Manitou Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Rockford Map Publishers, Inc., 1975). Their location suggests that the wetlands are under minimal development pressure especially since the entire island has been proposed as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977).

Recreation

Leland Township Wetland is located within the Sleeping Bear Dunes National Lakeshore. The park is administered by the National Park Service and provides a wide range of recreational activities including hiking, horseback riding, canoeing, and boating (U.S. National Park Service, 1975).

Mineral, Energy, and Forest Resources

No site-specific information was located pertaining to the nature and distribution of mineral resources in the North Manitou Island Wetland Complex, or to any operations exploiting those resources. There are no known oil, gas, or coal deposits on North Manitou Island (Michigan Geological Survey, 1977; Smith, 1915).

Leland Township Wetland and Tamarack Lake Wetland are wooded and lie within the Sleeping Bear Dunes National Lakeshore (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The principal management concern within the National Lakeshore is to preserve the natural qualities of the shoreline, so it is unlikely that Leland Township Wetland and Tamarack Lake Wetland will be subject to commercial timber operations.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Leland Township Wetland and Tamarack Lake Wetland (U.S.G.S. quadrangle map, North Manitou, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Leland Township Wetland and Tamarack Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Leland Township Wetland and Tamarack Lake Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 041-042

The literature search identified no on-going or impending research projects pertaining to Leland Township Wetland and Tamarack Lake Wetland.

GULL ISLAND WETLAND

PHYSIOGRAPHIC SETTING

LM 043

Setting

Gull Island Wetland is located 250 feet inland from the southern shoreline of Gull Island in Charlevoix County, Michigan, at the head of a small bay. The island has an area of 270 acres and a shoreline of 3.4 miles; it lies 6.5 miles west of High Island and 15 miles south of the mainland. The beaches of Gull Island are broad and rocky (Hatt et al., 1948). The wetland is a Lacustrine System and occupies a low, wooded site (U.S.G.S. quadrangle map, Gull Island, Michigan, 1955; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The relief of Gull Island Wetland is very slight; wetland elevations are at or near 585 feet above sea level, 5 feet above the approximate mean elevation of Lake Michigan. Gull Island is a small island having only slight relief; its highest point is less than 610 feet above sea level.

Surficial Geology

The surficial geology of Gull Island Wetland is unknown, since it has not been mapped by the Michigan Geological Survey (Martin, 1955).

Soils

The soil type in Gull Island Wetland is composed of an undifferentiated group of soils including Alpena, Kiva, and East Lake soils. The surface layer of this group ranges from gravelly sandy loam to gravelly sand. Alpena, Kiva, and East Lake soils are generally found in beach ridges, terraces, and sandy plains (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through Gull Island Wetland (U.S.G.S. quadrangle map, Gull Island, Michigan, 1955). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Gull Island Wetland.

Climate

The closest weather station providing climatic data for Gull Island Wetland is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and

1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

A sandbar extends southward from Gull Island Wetland, forming a small embayment. A second sandbar lies at the northern end of the island (U.S.G.S. quadrangle map, Gull Island, Michigan, 1955; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 043

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Gull Island Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Gull Island Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Gull Island Wetland.

Reptiles and Amphibians

General historical information on the amphibians and reptiles of the islands of eastern Lake Michigan was provided by Hatt et al. (1948). These authors recorded only the northern spring peeper (Hyla crucifer crucifer) on Gull Island, and remarked on the apparent absence of other species of amphibians and reptiles on this island despite the availability of suitable habitat.

Appendices C-3 and C-4 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Gull Island Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

General historical information on the birds of Gull Island is provided by Hatt et al. (1948). They report the presence of 50 species, of which at least 24 would be expected to have some association with wetlands. These species are listed in Table 3-9. Hatt et al. observed nine species of breeding birds, including the bald eagle (Haliaeetus leucocephalus). Other breeding species included the spotted sandpiper (Actitis macularia), herring gull (Larus argentatus), tree swallow (Iridoprocne bicolor), and the red-winged blackbird (Agelaius phoeniceus).

Gull Island was studied by Scharf et al. (1977) in an inventory of colonial nesting bird sites. In 1976, there were 1,330 active herring gull nests. The majority of nests were located on the periphery of the island, but there were nests wherever space was available. A sample of 133 nests indicated that an average of 2.84 eggs were laid per pair. A total of 193 chicks were counted, representing a hatching rate of 51.2%. Although herring gulls are more typical of open water and do not usually nest in wetlands, they do utilize wetland areas. A colony of this size would be expected to have a marked effect on the flora and fauna of the island. Scharf et al. (1977) suggest that nesting actually may retard the growth of vegetation and keep the nesting areas open.

Table 3-9. Birds Documented on Gull Island^a

common loon	purple martin ^b
great blue heron	common crow ^b
mallard	black-capped chickadee
black duck	red-breasted nuthatch
blue-winged teal	house wren
common goldeneye	brown thrasher
common merganser	American robin
red-breasted merganser ^b	veery
bald eagle ^b	eastern bluebird
marsh hawk	cedar waxing
killdeer	starling
spotted sandpiper ^b	red-eyed vireo
semipalmated sandpiper ^b	yellow warbler
herring gull ^b	ovenbird
black-billed cuckoo	mourning warbler ^b
chimney swift	American redstart ^b
common flicker	bobolink
pileated woodpecker	red-winged blackbird ^b
red-headed woodpecker	rose-breasted grosbeak ^b
eastern kingbird ^b	indigo bunting ^b
great crested flycatcher	pine siskin
eastern wood pewee ^b	American goldfinch
tree swallow	chipping sparrow
	song sparrow

^a Hatt et al. (1948)

^b breeding record

The literature search provided no site-specific information pertaining to seasonal abundance, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Gull Island Wetland.

Mammals

Snowshoe hare (Lepus americanus), deer mouse (Peromyscus maniculatus), and red fox (Vulpes vulpes) may utilize Gull Island Wetland (Hatt et al., 1928).

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Gull Island Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Gull Island Wetland by the literature search. However, the bald eagle, which is on the federal list, historically nested on Gull Island (Hatt et al., 1948). Hatt et al. also documented the occurrence of the marsh hawk (Circus cyaneus), threatened in Michigan, and the rare common loon (Gavia immer) and Caspian tern (Sterna caspia) on the island.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 043

Population

Gull Island is thought to be largely uninhabited, although some seasonal habitation may exist. Population figures for the island are not readily available.

Land Use and Ownership

Land use on Gull Island, including Gull Island Wetland, is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1973). Gull Island is under federal ownership (Rockford Map Publishers, Inc., 1976), so development pressures for Gull Island Wetland are likely to be minimal, especially since Gull Island has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning Commission, 1977).

Recreation

There are no known state or federal recreational facilities in the vicinity of Gull Island Wetland.

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of the mineral resources in Gull Island Wetland, or to any operations exploiting those resources. There are no known oil, gas, or coal deposits on Gull Island (Michigan Geological Survey, 1977; Smith, 1915).

Gull Island Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but owing to the small size of the island, it is unlikely that this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Gull Island Wetland (U.S.G.S. quadrangle map, Gull Island, Michigan, 1955).

Pollution Sources

There are no NPDES permit holders adjacent to Gull Island Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Gull Island Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a profession archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 043

The literature search identified no on-going or impending research projects pertaining to Gull Island Wetland.

BEAVER ISLAND WETLAND COMPLEX (NORTH)

PHYSIOGRAPHIC SETTING

LM 044-045

Setting

The Beaver Island Wetland Complex (North), comprised of Looney Point Wetland and Little Sandy Bay Wetland, is located on the northeastern shoreline of Beaver Island in Charlevoix County, Michigan. Beaver Island, with a surface area of 58 square miles, is the largest island in Lake Michigan. The island features eight lakes and ponds with a total surface area of 6.5 square miles (Hatt et al., 1948). Beaver Island features one area of high captured dunes, called "Mount Pisgah," located on the eastern shoreline. The island's beaches range from broad to narrow and consist of sand and, in at least one place, bedrock (Hatt et al., 1948).

Looney Point is a cusped bar forming the northern extent of Little Sandy Bay. Looney Point Wetland lies at the end of the bar, adjacent to the shoreline. The community of St. James is situated 1.5 miles to the northwest of the wetland. Looney Point Wetland is a Lacustrine System and occupies a low, partially wooded site. Little Sandy Bay Wetland is located adjacent to the shoreline, south of Little Sandy Bay and 2.2 miles southeast of the community of St. James. Little Sandy Bay Wetland is a Lacustrine System and occupies a low, partially wooded site. Both Looney Point Wetland and Little Sandy Bay Wetland lie within Pigeon River State Forest (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

Looney Point Wetland and Little Sandy Bay Wetland have elevations ranging from 580 to 590 feet above sea level, lake level to 10 feet above the approximate mean elevation of Lake Michigan; the total relief of each of these wetlands is 10 feet. The surface of the island is gently rolling to low, with large interior wetlands in the southern portion. The wetlands lie on a low lacustrine plain which generally circles Beaver Island; an area of low morainal hills is located inland of this plain. The island lies on the southwest-facing slope of the Bois Blanc Formation Cuesta (Hough, 1958).

Surficial Geology

The surficial geology of Looney Point Wetland and Little Sandy Bay Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Looney Point Wetland is Tawas-Carbondale muck and the soil type in Little Sandy Bay Wetland is Lake beaches. Tawas-Carbondale muck has a surface layer of black muck underlain by either peat or brownish-gray sand. These organic soils have low natural fertility and slow to ponded surface runoff, and are generally found in broad depressional areas or plains. Lake beaches consist of sand and gravel. Wave action from Lake Michigan has prevented the formation of a distinct profile in this soil type (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through either Looney Point Wetland or Little Sandy Bay Wetland (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Gull Island Wetland.

Climate

The closest weather station providing climatic data for Looney Point Wetland and Little Sandy Bay Wetland is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and 1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Beaver Island Harbor is situated to the north of the wetlands and Garden and Hog Islands lie offshore (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 044-045

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Looney Point Wetland and Little Sandy Bay Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Looney Point Wetland and Little Sandy Bay Wetland.

Invertebrates

Drew (1967) provides information on the spider fauna of Beaver Island. Two orb-web weavers, (Custala anatera), (Pachygnatha kuratai), a wolf spider (Pardosa modica), a crab spider (Xysticus elegans), and a jumping spider (Metaphidippus protervus), were collected in marsh habitat on the island. These species occur in Looney Point Wetland and Little Sandy Bay Wetland.

The literature search provided no site-specific data pertaining to other species, seasonal distribution and abundance, density and productivity, life histories, major food sources, or relationship to water levels of the invertebrates present in Looney Point Wetland and Little Sandy Bay Wetland.

Amphibians and Reptiles

General historical information on the amphibians and reptiles of Beaver Island is provided by Hatt et al. (1948). The documented species appear in Table 3-10.

Table 3-10. Amphibians and Reptiles Documented as Occurring on Beaver Island^a

central newt	snapping turtle
red-backed salamander	midland painted turtle
American toad	northern ringneck snake
gray treefrog	eastern milk snake
northern spring peeper	northern water snake
bullfrog	northern ribbon snake
green frog	eastern garter snake
northern leopard frog	wood frog

^a Hatt et al. (1948)

Appendices C-3 and C-4 contain general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Looney Point Wetland and Little Sandy Bay Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or

relationship to water levels of the reptiles and amphibians in this wetland complex.

Avifauna

Historical information on the birds of Beaver Island is found in Hatt et al. (1948), who recorded the presence of 139 species, 30 of which were nesting. More than half of these species would be expected to have some association with wetlands. An annotated list of the birds of the island based on Hatt et al. (1948) appears in Table 3-11.

Wood (1951) added the common loon (Gavia immer) and great blue heron (Ardea herodias) to the list of known breeders. Kelley (1974) noted two nests of the American bittern (Botaurus lentiginosus).

Beaver Island provides fair habitat for a variety of waterfowl (Ozoga, 1963). Black ducks (Anas rubripes), mallards (A. platyrhynchos), blue-winged teal (A. discors), ring-necked ducks (Aythya collaris), common goldeneye (Bucephala clangula), and red-breasted mergansers (Mergus serrator) have been commonly sighted along the Lake Michigan shore and the island's inland waters.

Ruffed grouse were introduced to Beaver Island during the 1940's; at times, the population has been very large, as in 1954 (Ozoga, 1963). According to Ozoga, the population density in general remains higher than that of the Upper Peninsula. Ozoga found that ruffed grouse and ducks constitute part of the diet of coyotes on Beaver Island, but that the majority of this food is obtained as carrion. He concluded that coyotes do not materially influence the island's ruffed grouse population. Ozoga regarded songbirds as supplemental in the coyote diet.

Table 3-11. Birds Recorded on Beaver Island^a

common loon	common snipe
Holboell's grebe	spotted sandpiper
horned grebe	solitary sandpiper
double-crested cormorant	greater yellowlegs
great blue heron	lesser yellowlegs
least bittern	least sandpiper
American bittern	herring gull
mallard	ring-billed gull
black duck	common tern
pintail	Caspian tern
blue-winged teal	black-billed cuckoo ^b
wood duck	belted kingfisher
redhead	common flicker
ring-necked duck	pileated woodpecker
canvasback	downy woodpecker
lesser scaup	yellow-bellied flycatcher
common goldeneye	will flycatcher

oldsquaw	olive-sided flycatcher
common merganser	tree swallow
goshawk ^b	bank swallow ^b
sharp-shinned hawk	barn swallow ^b
Cooper's hawk	cliff swallow ^b
red-tailed hawk	purple martin ^b
red-shouldered hawk	winter wren
bald eagle ^b	short-billed marsh wren
marsh hawk	veery
osprey	starling ^b
American kestrel	Nashville warbler
ring-necked pheasant	yellow warbler
Virginia rail	magnolia warbler
sora	mourning warbler
pipit ^b	common yellowthroat
killdeer ^b	red-winged blackbird
American woodcock	rusty blackbird
	purple finch ^b
	white-throated sparrow
	swamp sparrow

^a Hatt et al. (1948)
^b nesting record

Although its diversity of habitat and large size might suggest otherwise, Beaver Island is not documented as an important migration focal point by Scharf et al. (1977). However, Sheldon (1965) states that a hawk migration is known to occur on Beaver Island. He suggests that one important route of hawk migration is from the Leelanau Peninsula to the Beaver and Fox Island groups to Waugoshancē Point and then across the Straits of Mackinac. This route is followed during both spring and fall.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing the Beaver Island Wetland Complex (North).

Mammals

Mammalian species which may utilize the Beaver Island Wetland Complex (North) are listed in Appendix E-2.

Ozoga and Phillips (1964) compiled a short monograph about the mammals of Beaver Island. Little brown bats (Myotis lucifugus) were observed to forage in areas along the lake shore. Snowshoe hares (Lepus americanus) were more abundant on the northern portion of the island during the winter than on the southern portion. A total of 236 beaver (Castor canadensis) were legally trapped on Beaver Island from 1959 to 1963. Muskrats (Ondatra gibethicus) were frequently observed in many lakes of Beaver Island and were a major food item of coyotes (Canis latrans). Coyotes were most active on the northern half of the

island. Red fox (Vulpes vulpes) were most common on the southern and western portions of Beaver Island. White-tailed deer (Odocoileus virginianus) have been hunted on Beaver Island since 1938. White-tailed deer migrate to the southern portion of the island during the winter where coniferous cover is more dense.

The coyotes of Beaver Island have been the subject of many investigations. Curtis and Blouch (1962) found that adult coyotes predominated in the population. Only two litters per year were raised on Beaver Island. Single coyotes were more commonly observed than pairs.

Winter studies of the coyotes on Beaver Island (Ozoga, 1963; Ozoga and Harger, 1966) revealed that white-tailed deer carrion was a primary food source; coyotes killed few deer and relied on those which were killed and not retrieved during the hunting season. Other prey species were abundant and available, but coyotes were relatively unsuccessful in capturing them. Predation by coyotes on muskrat increased during periods of low water levels.

White-tailed deer hunting on Beaver Island has been monitored by the Michigan Department of Natural Resources to provide information on the harvest and hunter usage (Curtis, 1962; Johnson et al., 1963) and on hunter reaction to an early archery season (Moran, 1968).

The foregoing information pertains to Beaver Island as a whole, with no specific reference to wetland areas. The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the two wetlands comprising the Beaver Island Wetland Complex (North).

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program 1976) were documented specifically in the Beaver Island Wetland Complex (North) by the literature search. However, an historical nesting record of the now endangered bald eagle (Haliaeetus leucocephalus) on Beaver Island appears in Hatt et al. (1948). Hatt et al. also cited the occurrence of the double breasted cormorant (Phalacrocorax auritus), the Cooper's hawk (Accipiter cooperii), the red-shouldered hawk (Buteo lineatus), the marsh hawk (Circus cyaneus), the osprey (Pandion haliaetus), and the piping plover (Charadrius melodus), now threatened in Michigan. Hatt et al. also documented the occurrence of the rare common loon (Gavia immer), the sharp-shinned hawk (Accipiter striatus), and the Caspian tern (Sterna caspia). Kelley (1974) documented the nesting of the rare American Bittern (Botaurus lentiginosus) on Beaver Island.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

Population

The Beaver Island Wetland Complex (North) is located in the island township of Planine. In 1975, Planine Township contained only 55 persons and had shown no population growth since 1970 (U.S. Bureau of the Census, 1977). Located northwest of the wetlands is the community of St. James in St. James Township. St. James Township had a total population of 255 persons in 1975 and had shown a 44% growth rate between 1970 and 1975 (U.S. Bureau of the Census, 1977). No long-range population estimates are available for Beaver Island.

Land Use and Ownership

Land use within Looney Point and Little Sandy Bay Wetlands and in the surrounding area is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1973). The northern portion of Looney Point Wetland, comprising the greatest part of the wetland, is under state ownership. The remainder of Looney Point Wetland and all of Little Sandy Bay Wetland are under private ownership. An abandoned school lies inland from Looney Point Wetland, and an access road lies a short distance to the west of Little Sandy Bay Wetland (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Rockford Map Publishers, Inc., 1976). Development pressures in the two wetlands of the complex should be moderate to low, especially since Beaver Island has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning Commission, 1977).

Recreation

Looney Point Wetland and Little Sandy Bay Wetland lie within the Pigeon River State Forest. Although there are no known areas specifically designated for recreational use in or near the wetlands, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of the mineral resources in Looney Point Wetland and Little Sandy Bay Wetland, or to any operations exploiting those resources. There are no known oil, gas, or coal resources on Beaver Island (Michigan Geological Survey, 1977; Smith, 1915).

Looney Point Wetland and Little Sandy Bay Wetland are partially wooded and lie within Pigeon River State Forest (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). State forest lands in the coastal area are within a "water influence zone," in which water quality, water use, and aesthetic surroundings are the principal management concerns. Cover

treatments are designed to maintain or enhance these concerns, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Looney Point Wetland and Little Sandy Bay Wetland (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Looney Point Wetland and Little Sandy Bay Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Looney Point Wetland and Little Sandy Bay Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a profession archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 044-045

The literature search identified no on-going or impending research projects pertaining to Looney Point Wetland and Little Sandy Bay Wetland.

BEAVER ISLAND WETLAND COMPLEX (SOUTH)

PHYSIOGRAPHIC SETTING

LM 046-050

Setting

The Beaver Island Wetland Complex (South) is comprised of Jordan River Wetland, Point La Par Wetland, Beaver Island Interior Wetland, Kelly Point Area Wetland, and French Bay Wetland. These wetlands are located on the southern portion of Beaver Island in Charlevoix County, Michigan. All of the wetlands are within the Pigeon River State Forest.

Beaver Island, with a surface area of 58 square miles, is the largest island in Lake Michigan. The island features eight lakes and ponds with a total surface area of 6.5 square miles (Hatt et al., 1948). Beaver Island features one area of high captured dunes, called "Mount Pisgah," located on the western shoreline. The island's beaches range from broad to narrow and consist of sand, and, in at least one place, bedrock (Hatt et al., 1948).

The distances of the wetlands in the Beaver Island Wetland Complex (South) relative to the shoreline and to the community of St. James are given in Table 3-12.

Table 3-12. Location of Individual Wetlands in the Beaver Island Wetland Complex (South)

	Distance to shoreline (feet)	Distance to St. James, Michigan
Jordan River Wetland	900	5.5 miles south
Point La Par Wetland	800	6.4 miles south
Beaver Island Interior Wetland	500	4.5 miles south
Kelly Point Area Wetland	300	11.6 miles south
French Bay Wetland	adjacent	10.8 miles south

Jordan River Wetland lies on either side of the Jordan River, near the east shoreline of Beaver Island. A series of coastal beach ridges parallels the shoreline; the wetland occupies a narrow ravine within the ridges. A broad sand beach lies lakeward from the wetland. Jordan River Wetland is a lower perennial Riverine System and occupies a raised wooded site. Point La Par Wetland lies landward of beach ridges along the eastern shoreline of Beaver Island. A short, unnamed perennial stream flows out of this wetland and into Lake Michigan. Point La Par Wetland is a Palustrine System and occupies a raised, wooded site.

Beaver Island Interior Wetland occupies much of the southern interior portion of Beaver Island. The wetland generally lies to the east of Fox Lake

and to the north of Lake Geneserath. Several short perennial streams flow out of this wetland, and areas of dead trees are located within the wetland. Beaver Island Interior Wetland is a Palustrine System and occupies a raised, wooded site. Kelly Point Area Wetland is located near the southernmost portion of Beaver Island. The wetland lies behind a low (20 feet) bluffline. Kelley Point Area Wetland is a Palustrine System and occupies a raised, wooded site.

French Bay Wetland lies to the south of French Bay, at the southwestern end of Beaver Island. This wetland lies lakeward of a steep bluffline. French Bay Wetland is a Lacustrine System occupying a low, partially wooded site (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

Elevations within the Beaver Island Wetland Complex (South) range from 595 to 730 feet above sea level, 15 to 150 feet above the approximate mean elevation of Lake Michigan. The total relief and elevation of each of the wetlands in the wetland complex are indicated in Table 3-13.

Table 3-13. Elevations and Total Relief of Individual Wetlands in the Beaver Island Wetland Complex (South)

	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet) ^a
Jordan River Wetland	595	600	5
Point La Par Wetland	600	620	20
Beaver Island Interior Wetland	610	730	120
Kelly Point Area Wetland	600	620	20
French Bay Wetland	580	600	20

^a Elevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level

The surface of the island is gently rolling to low. Beaver Island Interior Wetland extends into an area of low morainal hills. The rest of the wetlands in the Beaver Island Wetland Complex (South) lie on a low lacustrine plain which generally circles the island. Beaver Island is situated on the southwest-facing slope of the Bois Blanc Formation Cuesta (Hough, 1958).

Surficial Geology

The surficial geology of the five wetlands of the Beaver Island Wetland Complex (South) is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are three soil types found in the Beaver Island Wetland Complex (South): Tawas-Carbondale muck, Roscommon sand, and Alpena, Kiva, and East Lake soils. Table 3-14 identifies the soil type for the individual wetlands in this complex.

Table 3-14. Soil Types for the Individual Wetlands in Beaver Island Wetland Complex (South)^a

	Soil
Jordan River Wetland	Tawas-Carbondale muck
Point La Par Wetland	Roscommon sand
Beaver Island Interior Wetland	Roscommon sand, and Tawas-Carbondale muck
Kelly Point Area Wetland	Tawas-Carbondale muck
French Bay Wetland	Alpena, Kiva, and East Lake

^a Alfred and Hyde, 1974

Roscommon sand has a surface layer of black sand underlain with brown and grayish-brown sand. This poorly drained soil has a high content of organic matter, low natural fertility, and slow to ponded surface runoff. Alpena, Kiva, and East Lake soils are undifferentiated because there is little value in separating them. The surface layer of this group ranges from gravelly sand loam to gravelly sand; these soils are generally found on beach ridges, terraces, and sand plains. Tawas-Carbondale muck has a surface layer of black muck underlain by either peat or brownish-gray sand. These organic soils have low natural fertility and slow to ponded surface runoff. Tawas-Carbondale muck is generally found in broad depressional areas or plains (Alfred and Hyde, 1974).

Hydrology

A tributary of the Jordan River flows north through Jordan River Wetland. This tributary originates in the wetland and flows to Lake Michigan. A short, unnamed perennial creek originates near the center of Point La Par Wetland and flows into Lake Michigan. The Jordan River begins in the northern part of Beaver Island Interior Wetland. Two short, unnamed perennial streams flow east from Beaver Island Interior Wetland to Lake Michigan, in addition to several small, unnamed streams which enter the wetland from the west. There are no

streams flowing through Kelly Point Area Wetland and French Bay Wetland (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in the wetlands of the Beaver Island Wetland Complex (South).

Climate

The closest weather station providing climatic data for the five wetlands comprising Beaver Island Wetland (South) is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and 1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Beaver Island Wetland Complex (South) (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Agricultural Stabilization and Conservation Service, aerial photograph, 1973).

BIOTIC SETTING

LM 046-050

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of the Beaver Island Wetland Complex (South).

Fish

Species found in Fox Lake, within Beaver Island Interior Wetland, have included smallmouth bass (Micropterus dolomieu), black crappie (Pomoxis nigromaculatus), and bluegill (Lepomis macrochirus). All three species have been successful in the lake and support a satisfactory sport fishery. Spawning occurs in shallow waters of the lake. Forage minnows are scarce, and black crappie and perch probably feed heavily on their own young and those of bluegill. Several other lakes on the island have been investigated, although none are associated with the other four wetlands of this complex. However, largemouth bass (Micropterus salmoides), rock bass (Ambloplites rupestris), bluntnose minnow (Pimephales notatus), black bullhead (Ictalurus melas), brown bullhead (Ictalurus nebulosus), pumpkinseed (Lepomis gibbosus), northern pike

(Esox lucius), and banded killifish (Fundulus diaphanus) have also been found in other interior waters on Beaver Island, in addition to the three species found in Fox Lake, and may occur in any of the five wetlands of this complex (Crowe, 1943). However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, recreational and commercial use, or food sources of the fish populations in Jordan River Wetland, Point La Par Creek Wetland, Kelly Point Area Wetland, or French Bay Area Wetland, or to commercial use or food sources of the fish populations in Beaver Island Interior Wetland.

Invertebrates

Drew (1967) provides information on the spider fauna of Beaver Island. Two orb-web weavers, (Custala anatera), (Pachygnatha kuratai), a wolf spider (Pardosa modica), a crab spider (Xysticus elegans), and a jumping spider (Metaphidippus protervus), were collected in marsh habitat on the island. These species occur in the five wetlands comprising the Beaver Island Wetland Complex (South).

The literature search provided no site-specific data pertaining to other species, seasonal distribution and abundance, density and productivity, life histories, major food sources, or relationship to water levels of the invertebrates present in the five wetlands.

Amphibians and Reptiles

General historical information on the amphibians and reptiles of Beaver Island was provided by Hatt et al. (1948). The documented species appear in Table 3-15.

Table 3-15. Amphibians and Reptiles Occurring in Beaver Island^a

central newt	snapping turtle
red-backed salamander	midland painted turtle
American toad	northern ringneck snake
gray treefrog	eastern milk snake
northern spring peeper	northern water snake
bullfrog	northern ribbon snake
green frog	eastern garter snake
northern leopard frog	wood frog

^a Hatt et al. (1948)

Appendices C-3 and C-4 contain general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to the Beaver Island Wetland Complex

(South). The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland complex.

Avifauna

Historical information on the birds of Beaver Island is found in Hatt et al. (1948), who recorded 139 species, more than half of which would be expected to have some association with wetlands. Hatt et al. list 30 species as nesting or suspected of nesting on Beaver Island. An annotated list of the birds of the island based on Hatt et al. (1948) appears in Table 3-16. Wood (1951) added the common loon (Gavia immer) and great blue heron (Ardea herodias) to the list of known breeders. Kelley (1974) noted two nests of the American bittern (Botaurus lentiginosus).

Beaver Island provides fair habitat for a variety of waterfowl (Ozoga, 1963). Black ducks (Anas rubripes), mallards (A. platyrhynchos), blue-winged teal (A. discors), ring-necked ducks (Aythya collaris), common goldeneye (Bucephala clangula), and red-breasted mergansers (Mergus serrator) are known to occur on Beaver Island. One important route of hawk migration is from the Leelanau Peninsula to the Beaver and Fox Island group to Waugoshance Point and then across the Straits of Mackinac; this route is followed during both spring and fall (Ozoga, 1963).

Ruffed grouse were introduced to Beaver Island during the 1940's; at times, the population has been very large, as in 1954 (Ozoga, 1963). According to Ozoga, the population density in general remains higher than that of the Upper Peninsula. Ozoga found that ruffed grouse and ducks constitute part of the diet of coyotes on Beaver Island, but that the majority of this food is obtained as carrion. He concluded that coyotes do not materially influence the island's ruffed grouse population. Ozoga regarded songbirds as supplemental in the coyote diet.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing the Beaver Island Wetland Complex (South).

Mammals

Mammalian species which may utilize the five wetlands of the Beaver Island Wetland Complex (South) are listed in Appendix E-2.

The information from general studies and surveys of Beaver Island discussed for the Beaver Island Wetland Complex (North) may also be useful in characterizing the five wetlands of the Beaver Island Wetland Complex (South). However, the literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting these wetlands.

Table 316 . Birds Recorded on Beaver Island^a

common loon	solitary sandpiper
Holboell's grebe	greater yellowlegs
horned grebe	lesser yellowlegs
double-crested cormorant	least sandpiper
great blue heron	herring gull
least bittern	ring-billed gull
American bittern	common tern
mallard	Caspian tern
black duck	black billed cuckoo ^b
pintail	belted kingfisher ^b
blue-winged teal	common flicker ^b
wood duck	pileated woodpecker
redhead	downy woodpecker
ring-necked duck	yellow-bellied flycatcher
canvasback	willow flycatcher
lesser scaup	olive-sided flycatcher
common goldeneye	tree swallow
oldsquaw	bank swallow
common merganser	barn swallow ^b
goshawk	cliff swallow ^b
sharp-shinned hawk	purple martin ^b
Cooper's hawk	winter wren
red-tailed hawk	short-billed marsh wren
red-shouldered hawk	veery
bald eagle ^b	starling ^b
marsh hawk	Nashville warbler
osprey	yellow warbler
American kestrel	magnolia warbler
ring-necked pheasant	mourning warbler
Virginia rail	common yellowthroat
sora	red-winged blackbird
pipin plover	rusty blackbird
killdeer ^b	purple finch ^b
American woodcock	white-throated sparrow
common snipe	swamp sparrow
spotted sandpiper	

^aHatt et al. (1948)

^bNesting record

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program 1976) were documented specifically in the Beaver Island Wetland Complex (South) by the literature search. However, an historical nesting record of the now endangered bald eagle (Haliaeetus leucocephalus) on Beaver Island appears in Hatt et al. (1948). Hatt et al. also cited the occurrence of the double crested cormorant (Phalacrocorax auritus), the Cooper's hawk (Accipiter cooperii), the red-shouldered hawk (Buteo lineatus), the marsh hawk (Circus cyaneus), the osprey (Pandion haliaetus), and the piping plover (Charadrius melodus), now threatened in Michigan. Hatt et al. also documented the occurrence of the rare common loon (Gavia immer), the sharp-shinned hawk (Accipiter striatus), and the Caspian tern (Sterna caspia). Kelley (1974) documented the nesting of the rare American Bittern (Botaurus lentiginosus) on Beaver Island.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

CULTURAL SETTING

LM 046-050

Population

The Beaver Island Wetland Complex (South) is located in the island township of Planine. Planine Township contained only 55 persons in 1975 and had shown no population growth since 1970 (U.S. Bureau of the Census, 1977). Located at the north end of the island is the community of St. James in St. James Township. St. James Township had a total population of 255 persons in 1975 and had shown a 44% growth rate between 1970 and 1975 (U.S. Bureau of the Census, 1977). No long-range population estimates are available for Beaver Island.

Land Use and Ownership

Land use within the five wetlands of the Beaver Island Wetland Complex (South) is rural open space, with occasional residences in the interior of the island and shoreline residences around the periphery of the island. Access roads lie lakeward of all of the wetlands in the Beaver Island Wetland Complex (South). Orchards are located next to Beaver Island Interior Wetland, and a lighthouse is near Kelly Point Area Wetland (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978; Agricultural Stabilization and Conservation Service aerial photograph, 1973). The southern portion of Beaver Island comprises the Pigeon River State Forest. Most of this area is under state ownership. Areas of private inholdings, however, are present in the Beaver Island Wetland Complex (South). All of the wetlands are under mixed (state-private) ownership, except French Bay Wetland which is under mixed (federal-state-private) ownership (Rockford Map Publishers, Inc., 1976).

Development pressures for these wetlands can be viewed as low to moderate, owing to extensive state and federal ownership. Beaver Island has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning Commission, 1977).

Recreation

The Beaver Island Wetland Complex (South) lies within the Pigeon River State Forest. Although there are no known areas specifically designated for recreational use in or near the wetlands, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of mineral resources in the Beaver Island Wetland Complex (South) or to any operations exploiting those resources. There are no known oil, gas, or coal resources on Beaver Island (Michigan Geological Survey 1977; Smith, 1915).

The wetlands of the Beaver Island Wetland Complex (South) are wooded and lie in the Pigeon River State Forest (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). State forest lands in the coastal area are within a "water influence zone," in which water quality, water use, and aesthetic surroundings are the principal management concerns. Cover treatments are designed to maintain or enhance these concerns, and timber harvesting within this area is conducted accordingly (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of the five wetlands of the Beaver Island Wetland Complex (South) (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to the five wetlands of the Beaver Island Wetland Complex (South) (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

Beaver Island Lighthouse is located near Kelly Point Area Wetland. The brick lighthouse tower was built in 1851 and is listed in the state historical register (Peebles and Black, 1976). Several archaeological sites are present in the vicinity of the Beaver Island Wetland Complex. Site 20-CX-16, located near Kelly Point Area Wetland, and site 20-CX-46, near Beaver Island Interior

Wetland, are both habitations of an unknown culture and date (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 046-050

The literature search identified no on-going or impending research projects pertaining to the five wetlands of the Beaver Island Wetland Complex (South).

HIGH ISLAND WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 051-057

Setting

The High Island Wetland Complex, comprised of High Island Wetlands #1-#7, is located on High Island (a member of the Beaver Island Group) in Charlevoix County, Michigan. The western shoreline of High Island has dunes and a bluffline that is subject to wave erosion. The eastern shoreline is low, and a crescent-shaped natural harbor (High Island Bay) lies at the island's northeastern corner. Hardwood forest covers much of High Island (Hatt et al., 1948). The island is included in the Pigeon River State Forest.

High Island Wetlands #1 and #2 are located approximately 0.2 mile from the Lake Michigan shoreline, while High Island Wetlands #3-#7 are adjacent to the shoreline. High Island Wetland #1 is situated near the northeastern end of the island, at the base of a long, partially vegetated sand and gravel bar extending into the lake towards Beaver Island. High Island Wetland #1 is a Palustrine System and occupies a raised, wooded site. High Island Wetlands #2 and #3 are located on the eastern shoreline of the island, where the beachline is low and rocky. Both of these wetlands are Palustrine Systems and occupy raised, wooded sites. High Island Wetlands #4 and #5 are located at the southern end of the island, and a small pond lies to the east of High Island Wetland #4. Both wetlands are Lacustrine Systems occupying low, wooded sites. High Island Wetlands #6 and #7 are located at the northwestern end of High Island, along a rocky shoreline which has several small sandbars. An area of wooded dunes and blowouts lies to the south of these wetlands. High Island Wetlands #6 and #7 are located at the northwestern end of High Island, along a rocky shoreline which has several small sandbars. An area of wooded dunes and blowouts lies to the south of these wetlands. High Island Wetlands #6 and #7 are Lacustrine Systems and occupy low, partially wooded sites (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

Elevations within the High Island Wetland Complex range from 580 to 606 feet above sea level (lake level to 26 feet above the approximate mean elevation of Lake Michigan). The elevation and total relief of the individual wetlands in the wetland complex are presented in Table 3-17.

Table 3-17. Elevations and Total Relief of Individual Wetlands in the High Island Wetland Complex

	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet) ^a
High Island Wetland #1	593	596	3
High Island Wetland #2	604	606	2
High Island Wetland #3	580	595	15
High Island Wetland #4	580	590	10
High Island Wetland #5	580	590	10
High Island Wetland #6	580	590	10
High Island Wetland #7	580	585	5

^a Elevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level

The coastal wetlands on High Island lie on a low lacustrine plain which generally circles the island; the island interior is a low morainal plateau. High Island is situated on the southwest-facing slope of the Bois Blanc Formation Cuesta (Hough, 1958).

Surficial Geology

The surficial geology of High Island Wetlands #1-#7 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are four soil types found in the High Island Wetland Complex: Deer Park-Dune land; Alpena, Kiva, and East Lake Soils; Roscommon sand; and Lake beach. Table 3-18 identifies the soil type for the individual wetlands in the wetland complex.

Table 3-18. Soil Types for the Individual Wetlands in High Island Wetland Complex^a

	Soil
High Island Wetland #1	Deer Park-Dune land
High Island Wetland#2	Alpena, Kiva, East Lake soils
High Island Wetland #3	Roscommon sand
High Island Wetland #4	Roscommon sand
High Island Wetland #5	Lake beach
High Island Wetland #6	Lake beach
High Island Wetland #7	Lake beach

^a Alfred and Hyde, 1974

Deer Park-Dune land soils consist mainly of sand and are generally found on beach ridges and dunes near the Lake Michigan shore. This soil type also includes areas of poorly drained soils found in swales. Alpena, Kiva, and East Lake soils are not differentiated because there is little value in separating them. The surface layer of this group ranges from gravelly sandy loam to gravelly sand. Alpena, Kiva, and East Lake soils are generally found on beach ridges, terraces, and sandy plains. Lake beach consists mainly of sand and gravel; wave action from Lake Michigan has prevented the formation of a distinct profile in this soil type. Roscommon sand has a surface layer of black sand underlain with brown and grayish-brown sand. This soil is poorly drained has a high organic matter content, low natural fertility, and slow to ponded surface runoff (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through High Island Wetlands #1-#7. High Island Wetlands #3-#7 are adjacent to Lake Michigan (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth or seasonal changes in High Island Wetlands #1-#7.

Climate

The closest weather station providing climatic data for High Island Wetland #1-#7 is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and 1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of High Island Wetlands #2 and #7 (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 051-057

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of High Island Wetlands #1-#7.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in High Island Wetlands #1-#7.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in High Island Wetlands #1-#7.

Reptiles and Amphibians

Hatt et al. (1948) provided general historical information on the amphibians and reptiles of the islands of eastern Lake Michigan. However, adequate collecting was not done on High Island. The only species for which definite records exist are the American toad (Bufo americanus), midland painted turtle (Chrysemys picta marginata), eastern milk snake (Lampropeltis t. triangulum), and eastern garter snake (Thamnophis s. sirtalis).

Appendices C-3 and C-4 contain general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to High Island Wetlands #1-#7.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Historical information on the avifauna of the islands in eastern Lake Michigan is provided in Hatt et al. (1948). No collecting was done on High Island during the 1937-1944 expeditions. However, nesting records are included for the common tern (Sterna hirundo) and Caspian tern (S. caspia).

Scharf et al. (1977) studied High Island in their survey of colonial nesting bird sites. In 1976, there were four active herring gull nests (Larus argentatus), 3,313 ring-billed gull nests (L. delawarensis), 411 common tern nests and 63 Caspian tern nests. Determination of productivity was difficult due to predation by coyotes (Canis latrans) and red foxes (Vulpes vulpes). Productivity of ring-billed gulls was termed fair in 1976. A number of common tern chicks capable of flight were observed, but predation was severe and considerable re-nesting had taken place. There was no evidence of canid predation in 1974. However, in 1975, productivity was essentially halted for all species, and canid predation was either directly or indirectly responsible. It was reported that chicks were being killed as soon as they hatched in 1975. The level of predation in 1976 appeared to be lower than the 1975 level.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing the seven wetlands of the High Island Wetland Complex.

Mammals

Snowshoe hare (Lepus americanus) may utilize the seven wetlands of the High Island Wetland Complex (Hatt et al., 1928).

The literature search provided no other site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting these wetlands.

Endangered Species

No plants or animals appearing on the federal or state lists or endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the High Island Wetland Complex by the literature search. However, the Caspian tern, which is rare in Michigan, is known to breed on High Island (Scharf et al., 1977).

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

Population

High Island is thought to be uninhabited at the present time, although there may be some seasonal habitation.

Land Use and Ownership

Land use within High Island Wetlands #1-#7 and the rest of the island is rural open space. Foot trails are located near High Island Wetlands #2 and #7 (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The island is under state ownership (Rockford Map Publishers, Inc., 1976), and development pressures in the wetlands are likely to be minimal, especially since High Island has been nominated as an "Area of Particular Concern" under Michigan's Coastal Zone Management Programs (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the island will be afforded further protection from development.

Recreation

High Island Bay Wetlands #1-#7 lie within the Pigeon River State Forest. Although there are no known areas specifically designated for recreational use in or near the wetlands, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of the mineral resources in High Island Wetlands #1-#7, or to any operations exploiting those resources. There are no oil, gas, or coal deposits on High Island (Michigan Geological Survey, 1977; Smith, 1915).

High Island Wetlands #1-#5 are wooded and High Island Wetlands #6 and #7 are partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). Given the size of the island as well as its ownership by the state, it is unlikely that commercial production of timber occurs in any of the wetlands.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of High Island Wetlands #1-#7 (U.S.G.S. quadrangle map, Beaver Island, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to High Island Wetlands #1-#7 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of High Island Wetlands #1-#7 (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that one archaeological site (20-CX-10, a habitation of unknown culture and date) is present in the vicinity of High Island Wetland #2 (Peebles and Black, 1976). Further information regarding the field research and exact location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 051-057

The literature search identified no on-going or impending research projects pertaining to High Island Wetlands #1-#7.

HOG ISLAND WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 058-068

Setting

The Hog Island Wetland Complex, comprised of Hog Island Wetlands #1-#11, is located on Hog Island (a member of the Beaver Island Group) in Charlevoix County, Michigan. Hatt et al. (1948) describe Hog Island as mostly low and wet, with thick forests of black ash. The island features broad, flat shores on the west, with many long ridges of rock and boulders extending from the northwest to the southeast. The distances of the wetlands in the Hog Island Wetland Complex relative to the lakeshore are indicated in Table 3-19.

Table 3-19. Distance to Lakeshore of Hog Island Wetlands #1-#11

	Distance to lakeshore (feet)
Hog Island Wetland #1	150
Hog Island Wetland #2	200
Hog Island Wetland #3	400
Hog Island Wetland #4	300
Hog Island Wetland #5	150
Hog Island Wetland #6	adjacent
Hog Island Wetland #7	1.5 miles
Hog Island Wetland #8	adjacent
Hog Island Wetland #9	300
Hog Island Wetland #10	adjacent
Hog Island Wetland #11	400

Hog Island Wetland #1 is located on the east side of the island. It lies in a shallow depression located at the head of a small bay, and a tombolo lies to the north. Hog Island Wetland #1 is a Palustrine System and occupies a low, wooded site. Hog Island Wetland #2 is located on the eastern shoreline of the island on a small headland. A pond lies a short distance inland from this wetland. Hog Island Wetland #2 is a Palustrine System and occupies a low, wooded site. Hog Island Wetland #3 lies at the southeastern end of the island; it is a Palustrine System occupying a raised, wooded site. Hog Island Wetlands #4-#6 are at the southern end of the island. Several small sandbars lie along the shoreline near these wetlands, and Grape Island lies offshore from Hog Island Wetland #6. Hog Island Wetlands #4-#6 are Lacustrine Systems and occupy low, partially wooded sites. Hog Island #7 lies inland from Hog Island Wetland #5. A small pond is located near the center of this Palustrine wetland, which occupies a raised, partially wooded site.

Hog Island Wetlands #8-#10 lie on the west side of the island. A series of sandbars and small embayments line the shoreline in the vicinity of the wetlands. Hog Island Wetlands #8-#10 are Lacustrine Systems and occupy low, partially wooded sites. Hog Island Wetland #11 lies near the head of Fisherman Bay on the northwestern end of Hog Island. It is a Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955; Agricultural Conservation and Stabilization Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

Elevations within Hog Island Wetland complex range from 580 to 597 feet above sea level (lake level to 17 feet above the approximate mean elevation of Lake Michigan). The elevation and total relief of the individual wetlands in the Hog Island Wetland Complex are presented in Table 3-20.

Hog Island as a whole is a low lacustrine plain with little relief. This plain is situated on the southwest-facing slope of the Bois Blanc Formation cuesta (Hough, 1958).

Surficial Geology

The surficial geology of Hog Island Wetlands #1-#11 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are three soil types found in Hog Island Wetlands #1-#11: Alpena, Kiva, and East Lake soils in Wetland #9; Lake beach in #8 and #10; and Tawas-Carbondale muck in wetlands #1-#7 and #11. Tawas-Carbondale muck has a surface layer of black muck underlain by either peat or brownish-gray sand. This organic soil has low natural fertility and slow to ponded surface runoff, and is generally found in broad depressional areas or plains. Lake beaches consist mainly of sand and gravel. Wave action from Lake Michigan has prevented the formation of a distinct profile in this soil type. Alpena, Kiva, and East Lake soils are undifferentiated because there is little value in separating them. The surface layer of this group ranges from gravelly sand loam to gravelly sand. Alpena, Kiva, and East Lake soils are generally found on beach ridges, terraces, and sandy plains (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through any of the wetlands in the Hog Island Wetland Complex, but Hog Island Wetlands #6, #8, and #10 are adjacent to Lake Michigan. Hog Island Wetlands #2, #4, #5, and #6 have small areas of open water in them (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955).

Table 3-20. Elevations and Total Relief of Individual Wetlands
in the Hog Island Wetland Complex

Wetland	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet)
Hog Island Wetland #1	585	590	5
Hog Island Wetland #2	585	590	5
Hog Island Wetland #3	593	595	2
Hog Island Wetland #4	588	590	2
Hog Island Wetland #5	585	590	5
Hog Island Wetland #6	585	590	5
Hog Island Wetland #7	594	596	2
Hog Island Wetland #8	580	590	10
Hog Island Wetland #9	585	590	5
Hog Island Wetland #10	580	590	10
Hog Island Wetland #11	594	597	3

^aElevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level.

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Hog Island Wetlands #1-#11.

Climate

The closest weather station providing climatic data for Hog Island Wetlands #1-#11 is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and 1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Several sand and gravel bars and small islands lie along the Hog Island shoreline (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 058-068

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Hog Island Wetlands #1-#11.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Hog Island Wetlands #1-#11.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Hog Island Wetlands #1-#11.

Reptiles and Amphibians

Appendices C-3 and C-4 contain general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Hog Island Wetlands #1-#11.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Hog Island was not studied extensively by Hatt et al. (1948) during their 1937-1944 expeditions. However, they provide a definite record of occurrence for the great blue heron (Ardea herodias), common crow (Corvus brachyrhynchos), black-throated green warbler (Dendroica virens), and the American redstart (Setophaga ruticilla) on Hog Island.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Hog Island Wetlands #1-#11.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the 11 wetlands comprising the Hog Island Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Hog Island Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

CULTURAL SETTING

LM 058-068

Population

Hog Island appears to be uninhabited at the present time.

Land Use and Ownership

Land use on Hog Island is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1973). The island is part of the Beaver Island State Game Area, and except for a small area on the western shore between Baltimore Bay and Fisherman Bay, it is under state and federal ownership (Rockford Map Publishers, Inc., 1976). Hog Island Wetlands #1, #2, #4-#7, #9

and #10 are state-owned; Hog Island Wetlands #3, #8, and #11 are under mixed state and federal ownership.

Developmental pressures on Hog Island Wetlands #1-#11 are likely to be minimal, especially since Hog Island has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the island will be afforded further protection from development.

Recreation

Hog Island Wetlands #1-#11 lie within the Beaver Island State Game Area. No specific information was located through the literature search pertaining to the recreational opportunities of the area.

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of mineral resources in Hog Island Wetlands #1-#11, or to any operations exploiting those resources. There are no oil, gas, or coal deposits on Hog Island (Michigan Geological Survey, 1977; Smith, 1915).

Hog Island Wetlands #1-#3 are wooded and Hog Island Wetlands #4-#11 are partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). Given the size of Hog Island as well as its government ownership, it is unlikely that commercial production of timber occurs in Hog Island Wetlands #1-#11.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Hog Island Wetlands #1-#11 (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955).

Pollution Sources

There are no NPDES permit holders adjacent to Hog Island Wetlands #1-#11 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Hog Island Wetlands #1-#11 (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that one archaeological site (20-CX-15, a habitation of unknown culture and date) is present near Hog Island Wetland #1 (Peebles and Black, 1976). Further information regarding the field research and location of this site can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 058-068

The literature search identified no on-going or impending research projects pertaining to Hog Island Wetlands #1-#11.

GARDEN ISLAND WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 069-073

Setting

The Garden Island Wetland Complex, comprised of Garden Island Wetlands #1-#3, Jensen Harbor Wetland, and Northcutt Bay Wetland, is located on Garden Island (a member of the Beaver Island Group) in Charlevoix County, Michigan. The island is largely forest-covered and features several small ponds. Garden Island is part of the Pigeon River State Forest.

Garden Island Wetlands #1 and #3 lie 400 feet from the lakeshore. Garden Island Wetland #2 lies 0.7 mile from the lakeshore, while Jensen Harbor Wetland and Northcutt Bay Wetland are adjacent to the shoreline. Garden Island Wetlands #1-#3 are located at the northern end of the island. These Palustrine wetlands lie on a gentle slope and occupy raised, partially wooded sites. Jensen Harbor Wetland lies at the head of Jensen Harbor, which is located on the eastern shoreline of Garden Island. Small ponds are contiguous with this wetland, and the beach here is very broad. Offshore depths are shallow, and it is likely that fluctuations in the level of Lake Michigan alter the size of the wetland. A series of coastal beach ridges lies along Jensen Harbor, landward of the wetland. Jensen Harbor Wetland is a Lacustrine System and occupies a low, partially wooded site. Northcutt Bay Wetland is located on the southern end of Garden Island, at the head of Northcutt Bay. This bay is separated from Monaton Bay, which lies to the east, by a small peninsula of low relief. An area of open water is located within the wetland. Northcutt Bay Wetland is a low, partially wooded Lacustrine System (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

Elevations in the Garden Island Wetland Complex range from 580 to 610 feet above sea level (lake level to 35 feet above the approximate mean elevation of Lake Michigan). The elevation and total relief of the individual wetlands in the wetland complex are presented in Table 3-21.

Table 3-21. Elevations and Total Relief of Individual Wetlands in the Garden Island Wetland Complex

	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet) ^a
Garden Island Wetland #1	610	615	5
Garden Island Wetland #2	607	610	3
Garden Island Wetland #3	600	605	5
Jensen Harbor Wetland	580	590	10
Northcutt Bay Wetland	580	590	10

^a Elevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level

Garden Island is a low lacustrine plain with little relief. This plain is situated on the southwest-facing slope of the Bois Blanc Formation Cuesta (Hough, 1958).

Surficial Geology

The surficial geology of the five wetlands of the Garden Island Wetland Complex is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are three soil types found in the five wetlands of the Garden Island Wetland Complex: Angelica-Ensley loams in Wetlands #1-#3, Tawas-Carbondale mucks in Jensen Harbor and Northcutt Bay Wetlands, and Lake Beach in Jensen Harbor Wetland.

Angelica-Ensley loams are poorly drained soils formed from loam till, with a surface layer of black loam underlain by grayish-brown loam and sandy loam. Angelica-Ensley loams have high natural fertility owing to organic matter; surface runoff and permeability of this soil are slow. Angelica-Ensley loams are generally found in swales and depressions. Tawas-Carbondale muck has a surface layer of black muck underlain by either peat or brownish-gray sand. This organic soil has low natural fertility and slow to ponded surface runoff, and is generally found in broad depressional areas or plains. Lake beaches consist mainly of sand and gravel. Wave action from Lake Michigan has prevented the formation of a distinct profile in this soil type (Alfred and Hyde, 1974).

Hydrology

There are no streams flowing through any of the wetlands in the Garden Island Wetland Complex. Jensen Harbor Wetland and Northcutt Bay Wetland are

adjacent to Lake Michigan and have areas of open water in them (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in the five wetlands of the Garden Island Wetland Complex.

Climate

The closest weather station providing climatic data for the Garden Island Wetland Complex is located in St. James-Beaver Island, Michigan. In 1975, the average monthly temperature was 44.3°F, the average daily low for January was 19.5°F and the average daily high in July was 78.0°F. The average annual precipitation is 29.23 inches, with a mean monthly precipitation of 2.62 inches in January and 1.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 22 and the first killing frost on November 14 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Several sand and gravel bars and small islands lie along the Garden Island shoreline (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 069-073

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of the Garden Island Wetland Complex.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in the Garden Island Wetland Complex.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in the Garden Island Wetland Complex.

Reptiles and Amphibians

Historical information on the reptiles and amphibians of the islands in eastern Lake Michigan is provided in Hatt et al. (1948). Appendix C-3 contains general information on the reptiles and amphibians of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to the Garden Island Wetland Complex.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

General information on the avifauna of the islands in eastern Lake Michigan is provided in Hatt et al. (1948). No collecting was done in Garden Island, however. The only occurrences listed for the island are a record for the spotted sandpiper (Actitis macularia) and a nesting report for the common tern (Sterna hirundo).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing the Garden Island Wetland Complex.

Mammals

Mammalian species which may utilize the Garden Island Wetland Complex are listed in Table 3-22.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the five wetlands comprising the Garden Island Wetland Complex.

Table 3-22. Mammalian Species of Garden Island^a

Common name	Common name
masked shrew	muskrat
little brown bat	coyote
snowshoe hare	red fox
eastern chipmunk	river otter
beaver	bobcat
deer mouse	white-tailed deer

^a Moran, 1964; Phillips et al., 1965; King, 1971

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Garden Island Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

CULTURAL SETTING

LM 069-073

Population

Garden Island appears to be uninhabited at the present time.

Land Use and Ownership

Land use for all of Garden Island is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1973). The island is part of the Beaver Island State Game Area and the Pigeon River State Forest. Garden Island is largely under state ownership. The only significant areas of private inholdings occur in the Indian Harbor area (Rockford Map Publishers, Inc., 1976).

State ownership and the lack of existing development suggest that developmental pressures for the wetlands of the Garden Island Wetland Complex are minimal, especially since Garden Island has been nominated as an "Area of Particular Concern" under Michigan's Coastal Zone Management Program (Northwest Michigan Regional Planning and Development Commission, 1977). Should the nomination be approved, the island will be afforded further protection from development.

Recreation

The Garden Island Wetland Complex lies within the Pigeon River State Forest and the Beaver Island State Game Area. Although there are no known areas specifically designated for recreational use in or near the wetlands, all Michigan state forest lands are open for camping unless otherwise posted. Hunting and fishing are also major uses of state forest lands (Henry H. Webster, Michigan Department of Natural Resources, personal communication).

Mineral, Energy, and Forest Resources

No site-specific information was located through the literature search pertaining to the nature and distribution of mineral resources in the Garden Island Wetland Complex, or to any operations exploiting those resources. There

are no oil, gas, or coal resources on Garden Island (Michigan Geological Survey 1977; Smith, 1915).

The five wetlands of the Garden Island Wetland Complex are partially wooded and lie within Pigeon River State Forest (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). Given the size of Garden Island as well as its state ownership, it is unlikely that commercial production of timber occurs in any of the wetlands.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of the five wetlands of the Garden Island Wetland (U.S.G.S. quadrangle map, Hog Island, Michigan, 1955).

Pollution Sources

There are no NPDES permit holders adjacent to the five wetlands comprising the Garden Island Wetland Complex (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of the Garden Island Wetland Complex, nor are there any known archaeological sites in the vicinity (Peebles and Black, 1976). However, the entire island should be considered as an archaeologically "sensitive area," since native cultures have long used the island for habitations and for burials (Hatt et al., 1948).

RESEARCH PROJECTS

LM 069-073

The literature search identified no on-going or impending research projects pertaining to the Garden Island Wetland Complex.

BETSIE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 074

Setting

Betsie River Wetland is located on either side of the Betsie River, which flows into Lake Michigan near the community of Frankfort in Benzie county, Michigan. Betsie Lake lies at the river mouth; the wetland extends inland from Betsie Lake for a distance of approximately 1.8 miles. The distance between Betsie River Wetland and the Lake Michigan shoreline is more than 1,000 feet; however, the wetland is included in this study because it is contiguous with Betsie Lake, which is influenced by Lake Michigan. The community of Elberta lies 1,000 feet to the west of the wetland, and Crystal Lake is 2.5 miles to the north. Betsie River Wetland occupies a low site and is a partially wooded, low perennial Riverine System (U.S.G.S. quadrangle map, Frankfort, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Betsie River Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level (lake level to 10 feet above the approximate mean elevation of Lake Michigan). The wetland occupies a low lacustrine area, and high-relief sand dunes are common nearby (Sommers, 1977). The shoreline near Betsie River Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff featuring a sand and gravel beach.

Surficial Geology

The surficial geology of Betsie River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found in a relatively small area on either side of the Betsie River (Martin, 1957; Dorr and Eschman, 1970).

Soils

No modern soil survey has been prepared for Benzie County. The soil type in Betsie River Wetland is not known.

Hydrology

The Betsie River flows west through the center of Betsie River Wetland. The river has a drainage area of 252 square miles. The western edge of the wetland has several inlets and is adjacent to Betsie Lake (U.S.G.S. quadrangle map, Frankfort, Michigan, 1956). Water quality in the Betsie River basin is considered to be very good except for Betsie Lake, which has substandard water quality (Great Lakes Basin Commission, 1975). However, the literature search provided no site-specific data pertaining to water level influences,

groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Betsie River Wetland.

Climate

The closest weather station providing climatic data for Betsie River Wetland is located in Frankfort, Michigan. In 1975, the average monthly temperature was 45.7°F, the average daily low for January was 19.1°F and the average daily high in July was 77.5°F. The average annual precipitation is 36.08 inches, with a mean monthly precipitation of 2.71 inches in January and 1.99 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on November 24 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Betsie River Wetland (U.S.G.S. quadrangle map, Frankfort, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 074

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Betsie River Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Betsie River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Betsie River Wetland.

Reptiles and Amphibians

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Betsie River Wetland.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The Betsie River State Game Area includes Betsie River Wetland and, in addition, some adjacent upland areas. Betsie River Wetland is considered to be one of the better wetland habitats in this part of Michigan. The primary value of the area is for waterfowl, as a nesting and migrational resting site. Spring and fall concentrations range between approximately 500 and 1,000 birds. The major nesters and migrant species using the area are mallards (Anas platyrhynchos), black ducks (A. rubripes), blue-winged teal (A. discors), and wood ducks (Aix sponsa). Considerable numbers of bufflehead (Bucephala albeola), and goldeneye (B. clangula) congregate here in winter (Betsie River State Game Area Management Program, undated).

Canada geese (Branta canadensis) were introduced in the early 1950's and at least two releases have been made since then, including a release of 10 pairs in the summer of 1973. The resident fall flock ranges from approximately 40 to 75 birds. Small migrating flocks of Canada geese and snow geese (Chen caerulescens) use the area infrequently. Mute swans from the Traverse City flock regularly use the area for nesting, resting, and feeding, with at least two pairs nesting there each year. Coots, rails, herons, bitterns, several species of sandpiper, gulls, terns, kingfishers, snipe, and a variety of song birds are also known to utilize the area regularly.

Scharf et al. (1977) note that Betsie River Wetland provides an excellent shorebird, passerine, and hawk migration resting spot. The wetland is in the pathway of many other local migratory focal points and seems to be a primary resting place for large numbers of birds. Although some wetlands decrease in value with high water levels, Betsie River Wetland has experienced high lake levels yet remained an important migration site (Jaworski and Raphael, 1978).

About one-half of the Betsie River State Game Area is a waterfowl sanctuary, in which hunting and trapping are prohibited. The remaining half has no restrictions on public use. Hunting activity in the area outside the sanctuary is light, however. The area affords excellent opportunities for bird watching, and this activity probably accounts for the greatest human use of the area (Michigan Betsie River State Game Area Management Program, undated).

The Beulah Christmas Bird Count census area encompasses Betsie River Wetland. Table 3-23 is an annotated summary of the 1972 and 1974-76 counts (there was no count in 1973). It is apparent that common goldeneyes, mallards, scaups, mergansers, and gulls are well represented in the early winter bird population of this area. The literature search provided no site-specific information pertaining to commercial use, life histories, or food sources of the birds utilizing Betsie River Wetland.

Table 3-23. Wetland Bird Species of the Beulah Census Area in the 1972 and 1974-1976 Christmas Bird Counts

Species	1976	1975	1974	1972
horned grebe	--	14	1	2
mute swan	31	64	15	4
mallard	408	357	306	17
black duck	101	49	104	--
gadwall	1	1	11	--
scaup spp.	22	88	68	55
common goldeneye	387	233	225	112
bufflehead	40	64	31	6
white-winged scoter	12	3	20	--
hooded merganser	1	1	10	--
common merganser	68	47	24	17
red-breasted merganser	7	5	7	--
Cooper's hawk	--	2	1	1
herring gull	97	634	170	304
ring-billed gull	46	66	28	270
gull spp.	1945	3162	6218	500
screech owl	1	1	1	--
great horned owl	7	^b	1	--
barred owl	6	1	3	1
belted kingfisher	2	1	8	--
pileated woodpecker	6	^b	1	1
starling	31	497	97	25
cardinal	40	86	47	7

^aArbib (1973, 1975, 1976, 1977)

^bObserved in the area during the count week, but not seen on the count day.

Mammals

Mammalian species commonly found on Betsie River Wetland are listed in Table 3-24. A few bank beaver (Castor canadensis) can be found on the upper part of the Betsie River, but their numbers are limited by the available food supply (Michigan Department of Natural Resources, undated).

On the eastern half of Betsie River Wetland, hunting of white-tailed deer (Odocoileus virginianus) and snowshoe hare (Lepus americanus) is good (Michigan Department of Natural Resources, undated). Trapping for muskrat (Ondatra zibethicus), raccoon (Procyon lotor), and mink (Mustela vison) is an infrequent activity. The western half (section 35) of this wetland is closed to hunting and trapping.

Table 3-24. Common Mammalian Species of Betsie River Wetland^a

<u>Common name</u>	<u>Common name</u>
snowshoe hare	mink
muskrat	river otter
red fox	striped skunk
raccoon	white-tailed deer
weasel	

^a Michigan Department of Natural Resources, undated

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, density and productivity, life histories, food sources, or relationship to water levels of the mammals inhabiting Betsie River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program 1976) were documented in Betsie River Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Betsie River Wetland is very good for waterfowl and game mammals.

Information is insufficient to evaluate this wetland as habitat for fish or for reptiles and amphibians.

Population

Betsie River Wetland is located in Crystal Lake Township of Benzie County, Michigan. The county is sparsely populated, having a density of 27 persons per square mile. Table 3-25 indicates that Benzie County experienced a rapid rate of population growth between 1970 and 1975, but the population of Crystal Lake Township remained stable during the same time period. Projections for 1990 indicate that Benzie County is expected to undergo continued rapid population growth.

Table 3-25. Population Data for the Vicinity of Betsie River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Benzie County	9,870	14.9	13,389
Crystal Lake Township	537	0.6	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Betsie River Wetland is rural open space. The surrounding area is primarily in agricultural and other rural open space uses, but the communities of Elberta and Frankfort are situated near the western portion of the wetland. Two bridges cross Betsie Lake a short distance to the northwest of Betsie River Wetland. A rail line and a secondary highway are located to the north of the wetland, and drainage ditches have been dug through the central portion of the wetland (U.S.G.S. quadrangle map, Frankfort, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under state ownership (David J. Warner, Northwest Michigan Regional Planning and Development Commission, personal communication), so development pressures are likely to be low, especially since the wetland is part of a proposed "Area of Particular Concern" under Michigan's Coastal Zone Management Program. If the program's plan is accepted, the wetland may receive protection as a "natural area."

Recreation

The 697-acre Betsie River State Game Area is divided into two parts: the eastern half is a dedicated wildlife sanctuary, while the western half is unrestricted, for public use. The primary recreational use of the area is bird watching. Hunting and trapping are allowed in the unrestricted area but use for these purposes is light. Cross country ski trails and snowmobile trails cross the western portion of the area (Betsie River State Game Area Management Program, undated).

Mineral, Energy, and Forest Resources

Betsie River Wetland lies within the northern boundary of an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in the area exploiting this resource (Gere, 1977). No oil, gas, or coal resources are present in or near the wetland (Michigan Geological Survey, 1977; Smith, 1915).

Betsie River Wetland is partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Betsie River Wetland (U.S.G.S. quadrangle map, Frankfort, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Betsie River Wetland Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Betsie River Wetland nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 074

The literature search identified no on-going or impending research projects pertaining to Betsie River Wetland.

ARCADIA LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 075

Setting

Arcadia Lake Wetland is located 0.8 mile from the eastern shoreline of Lake Michigan in Manistee County, Michigan, 0.2 mile east of the community of Arcadia. The wetland is contiguous with Arcadia Lake, and is included in this study because the water levels of Arcadia Lake are influenced by Lake Michigan. Arcadia Lake is connected to Lake Michigan by a short dredged channel protected by lakeshore navigational aids. Much of Arcadia Lake Wetland has been drained, and a canal cuts through the wetland. The northern portion of the wetland was previously wooded, but the entire wetland is now non-wooded. Arcadia Lake Wetland is a Lacustrine and lower perennial Riverine System (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Arcadia Lake Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level (lake level to 10 feet above the approximate mean elevation of Lake Michigan). The wetland is situated in a low lacustrine area and is surrounded by morainal hills and sand dunes. The shoreline near Arcadia Lake Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff.

Surficial Geology

The surficial geology of Arcadia Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found in a relatively small area surrounding the community of Arcadia (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Arcadia Lake Wetland is Muck. The surface layer of Muck is usually dark and loamy and consists of organic material, with coarse and fibrous, less decomposed matter below the surface. This soil is poorly drained and is generally found in depressions and along waterways (Wheeting and Bergquist, 1926).

Hydrology

Bowens Creek, a perennial stream, flows west through the center of Arcadia Lake Wetland into Arcadia Lake. The southwestern part of the wetland is

adjacent to Arcadia Lake (U.S.G.S. quadrangle map, Onekama, Michigan, 1956). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Arcadia Lake Wetland.

Climate

The closest weather station providing climatic data for Arcadia Lake Wetland is located in Frankfort, Michigan. In 1975, the average monthly temperature was 45.7°F, the average daily low for January was 19.1°F and the average daily high in July was 77.5°F. The average annual precipitation is 36.08 inches, with a mean monthly precipitation of 2.71 inches in January and 1.99 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on November 24 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Arcadia Lake Wetland (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 075

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Arcadia Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Arcadia Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Arcadia Lake Wetland.

Reptiles and Amphibians

Gelston (1971, 1972, and personal communication) has reported that snapping turtles (Chelydra serpentina) are present in Arcadia Lake Wetland. These turtles are important predators on mute swan fledglings.

Appendix C-3 contains general information on the amphibians and reptiles of Lake Section 3, but care should be exercised in the interpretation of the relevance of this information to Arcadia Lake Wetland.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Arcadia Lake Wetland was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance as an inadequately protected high quality waterfowl habitat (Martz, 1976). Primary waterfowl users of the area are dabbling ducks, including mallards (Anas platyrhynchos), and blue-winged teal (A. discors). Estimates of waterfowl production and migrational use are presented in Table 3-26.

The Mississippi Flyway Waterfowl Habitat Reconnaissance had noted four mute swan (Cygnus olor) nests in Arcadia Lake Wetland at the time of writing (Martz, 1976). In 1978, only one nest was present (W. L. Gelston, personal communication). Decreased utilization of the wetland by mute swans and other waterfowl is due to the falling water level since 1975, which has resulted in less open water. Accompanying the falling water level is a change in vegetation from predominantly bulrush to a thick grass mat, less favorable for waterfowl habitat. According to W. L. Gelston (personal communication), utilization of Arcadia Lake Wetland by waterfowl is much greater when water levels are high. However, the low survivorship of swan fledglings in Arcadia Lake Wetland is due to heavy predation by snapping turtles as well as to high water levels (W. L. Gelston, personal communication). In 1970, of six mute swan eggs laid, five chicks fledged but none survived due to predation by turtles; in 1971, of three eggs laid, non hatched owing to high water (Gelston, 1971, 1972).

Arcadia Lake Wetland does not appear to be an important focal point in passerine or hawk migration (W. L. Gelston, personal communication). However, considerable numbers of red-winged blackbirds (Agelaius phoeniceus) inhabit the wetland. Green herons (Butorides striatus) and great blue herons (Ardea herodias) are also present. Whistling swans (Olor columbianus) utilize the wetland as a migrational stopover in the spring, and sandhill cranes (Grus canadensis) are transient visitors to the area. Sandhill cranes were reported in Arcadia Lake Wetland during the spring of 1978 (W. L. Gelston, personal communication).

The literature search provided no site-specific information pertaining to recreational and commercial use, life histories, or food sources of the birds utilizing Arcadia Lake Wetland.

Table 3-26. Estimated Waterfowl Production in Arcadia Wetlands^a

Species	Production		Migration			Wintering		
	Avg density (prs/sq mi)	Avg young/ wetland acre	Avg peak population	Avg fall population	Avg duration (no. weeks)	Avg peak population	Avg wintering population	Avg. duration (no. weeks)
DUCKS								
mallard	32	0.37	100	50	4	20	10	12
black duck	8	0.07	50	20	4	10	5	12
green-winged teal			30	15	2			
wigeon								
blue-winged teal	32	0.37	50	20	2			
wood duck	8	0.07	30	15	2			
Sub-dabblers	50	0.88	260	120		30	15	
redhead			15	7	2			
scaup			30	15	2			
ring-necked			30	15	2			
bufflehead			30	15	4	6	3	12
Sub-divers			105	52		6	3	
Total Ducks	50	0.88	365	172		36	18	
GEESE								
Canada goose			150	7	6			
Total Geese	0	0	150	7				
SWANS								
mute swan	32	0.10	30	30	6	2	1	12
Total Swans	32	0.10	30	30		2	1	
Total Waterfowl	82	0.98	555	209		38	19	

^aMartz, 1976

Mammals

Arcadia Lake Wetland was exceptional muskrat (Ondatra zibethicus) habitat at one time (Jaworski and Raphael, 1978) and muskrat trapping used to be heavy. At the present time, however, few muskrat and no beaver (Castor canadensis) are found on this wetland (W. L. Gelston, personal communication). The muskrat population is estimated to be 35 to 40 animals.

The literature search provided no site-specific data pertaining to seasonal distribution and abundance, productivity, life histories, food sources, or relationship to water levels of the mammals inhabiting Arcadia Lake Wetland.

Endangered Species

The sandhill crane, which is rare in Michigan, is reported to use Arcadia Lake Wetland as a stopover during migration (W. L. Gelston, personal communication). However, no plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in this wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Arcadia Lake Wetland is very good for waterfowl.

Information is insufficient to evaluate this wetland as habitat for fish, mammals, or reptiles and amphibians.

CULTURAL SETTING

LM 075

Population

Arcadia Lake Wetland is located in Arcadia Township of Manistee County, Michigan. The county is sparsely populated, having a density of 37 persons per square mile. Table 3-27 indicates that Manistee County experienced a rapid rate of population growth between 1970 and 1975, but Arcadia Township experienced a slow rate of population decline during the same time period. Projections for 1990 indicate that Manistee County is expected to undergo continued rapid population growth.

Table 3-27. Population Data for the Vicinity of Arcadia Lake Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Arcadia Township	580	-2.0	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Arcadia Lake Wetland is rural open space. The surrounding area is primarily in agricultural and other rural open space uses, with an area of residential and commercial development (the community of Arcadia) almost immediately west of the wetland. Primary and secondary roads surround Arcadia Lake Wetland, and a canal crosses the wetland (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland is under private ownership (Rockford Map Publishers, Inc., 1974).

Much of Arcadia Lake Wetland has been drained, and a canal cuts through the wetland. In addition, the wooded areas in the northern portion of the wetland have been cut. Given the amount of wetland alteration that has already taken place, developmental pressures for Arcadia Lake Wetland are assumed to be high. Martz (1976) expects the wetland to face development in five or more years.

Recreation

There are no known state or federal recreational facilities in Arcadia Lake Wetland.

Mineral, Energy, and Forest Resources

Arcadia Lake Wetland lies in an area of Silurian salt deposits underlain by Devonian salt deposits, but there are no operations in the area exploiting this resource (Gere, 1977). Although there are no wells in the vicinity of the wetland, this area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975). An active sand and gravel operation is located directly south of the wetland (Michigan Department of State Highways and Transportation aerial photograph, 1973). There are no remaining forest resources in the wetland (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Arcadia Lake Wetland (U.S.G.S. quadrangle map, Onkama, Michigan, 1956). However, the Consumers Power Company projects construction of a pump storage facility to begin around 1985 at a site north of Arcadia Lake Wetland (Northwest Michigan Regional Planning and Development Commission, 1977).

Pollution Sources

There are no NPDES permit holders adjacent to Arcadia Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Arcadia Lake Wetland nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 075

The literature search identified no on-going or impending research projects pertaining to Arcadia Lake Wetland.

Table . Data Gaps - Lake Section 3

Data Gap ^a		Wetland Number	037	038	039	040	041-042	043	044-045	046-050	051-057	058-068	069-073	074	075	
Physiographic Setting	Setting															
	Topography															
	Surficial Geology							*								
	Soils															
	Hydrology	Water Level Fluctuations		*	*	*	*	*	*	*	*	*	*	*	*	*
		Groundwater		*	*	*	*	*	*	*	*	*	*	*	*	*
		Water Quality		*	*	*	*	*	*	*	*	*	*	*	*	*
		Depth		*	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Changes		*	*	*	*	*	*	*	*	*	*	*	*	*
	Climate															
	Special Features															
	Biotic Setting	Vegetation	Major Species Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*
Major Species Composition			*	*	*	*	*	*	*	*	*	*	*	*	*	
Density/Productivity			*	*	*	*	*	*	*	*	*	*	*	*	*	
Relationship to Water Levels			*	*	*	*	*	*	*	*	*	*	*	*	*	
Fish		Major species	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Spawning and Hatching Areas	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Commercial/Recreational Use	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	
Invertebrates		Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	
Amphibians/Reptiles		Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	
Aves		Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*		
Mammals	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*		
Cultural Setting	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Endangered Species															
	Health	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Population															
	Land Use and Ownership															
	Recreation															
	Mineral, Energy, Forest Resource															
	Public Utilities/Facilities															
	Point Pollution Sources															
	Non-Point Pollution Sources	*	*	*	*	*	*	*	*	*	*	*	*	*		
Historic Features																
Archaeologic Features	*	*	*	*	*	*	*	*	*	*	*	*	*			

LAKE SECTION 4

INTRODUCTION

Lake Section 4 extends along the eastern shoreline of Lake Michigan from Lookout Point, north of Portage Lake, to the City of North Muskegon. The lake section is situated in the Michigan counties of Manistee, Mason, Oceana, and Muskegon. All of these counties are sparsely populated except for Muskegon County, which has a moderate population density.

Many of the wetlands in Lake Section 4 lie more than 1,000 feet from the shoreline of Lake Michigan. These wetlands are included in this study because they are closely associated with bodies of water influenced by the levels of Lake Michigan. Several of the wetlands are very large and extend up to 17 miles inland, most notably Manistee River Wetland, Pere Marquette River Wetland, and White River Wetland. The topography in the vicinity of the wetlands of Lake Section 4 ranges from low lacustrine plain to rolling morainal plain. Predominant shore types in the vicinity of the wetlands are erodible low and high bluffs and low and high sand dunes (Great Lakes Basin Commission, 1975).

Figures 4-1, 4-2, and 4-3 show the approximate location of the 31 wetlands in Lake Section 4. Latitude, longitude, acreage, and classification for each of these wetlands are presented in Table 4-1. Elevations of these wetlands range from 580 to 660 feet above sea level (lake level to 80 feet above the approximate mean elevation of Lake Michigan). The majority of the wetlands are Lacustrine Systems, but Palustrine and Riverine Systems are also common.

Information related to the physiographic and cultural features of the wetlands in Lake Section 4 is summarized in the individual wetland narratives presented in this chapter. Site-specific information on the biotic characteristics of these wetlands is lacking in most instances. However, site-specific biotic data are available for Manistee River Wetland, Pere Marquette River Wetland, Pentwater River Wetland, and White River Wetland.

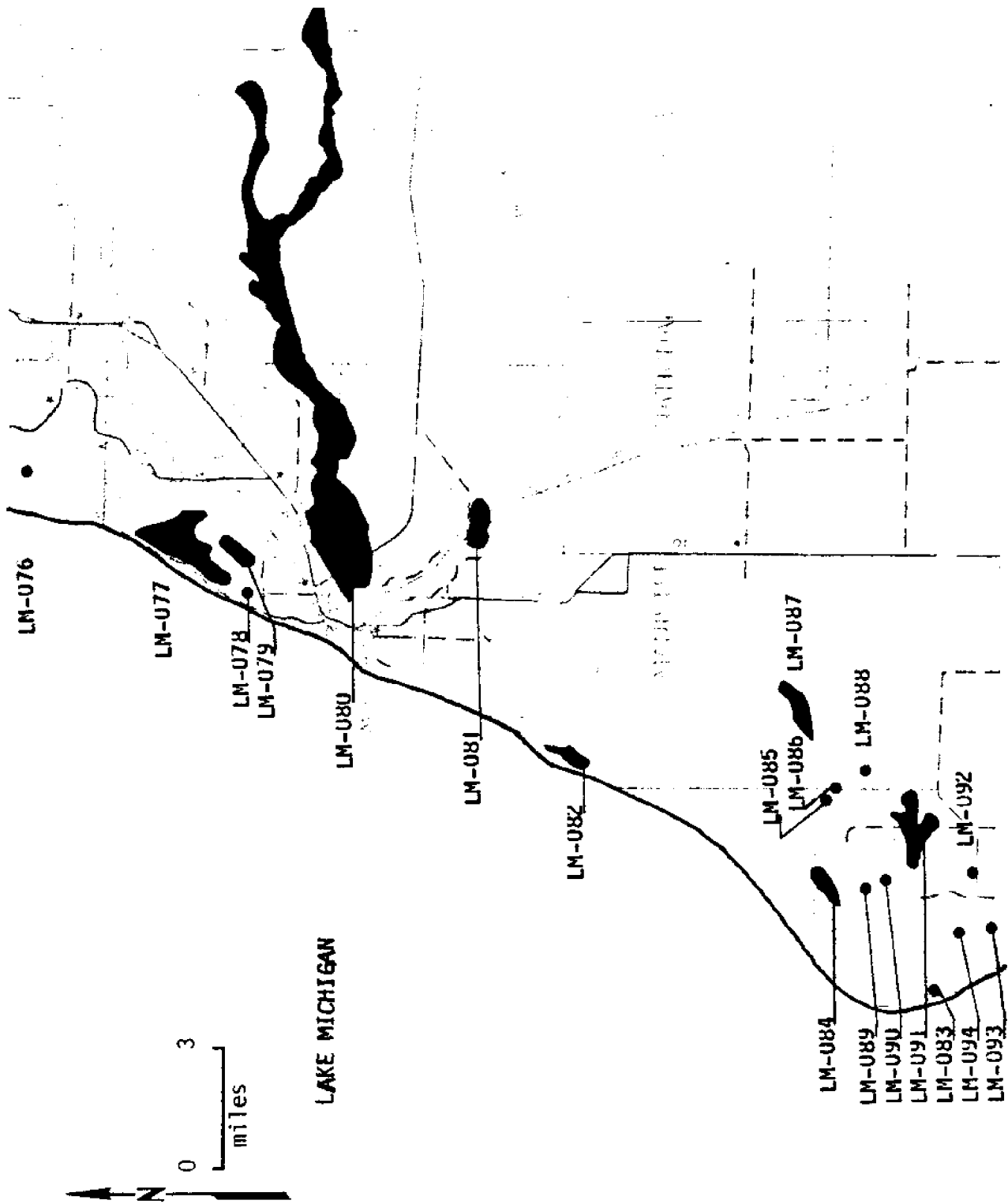


Figure 4-1. Lake Section 4 - Manistee National Forest Area
-254-

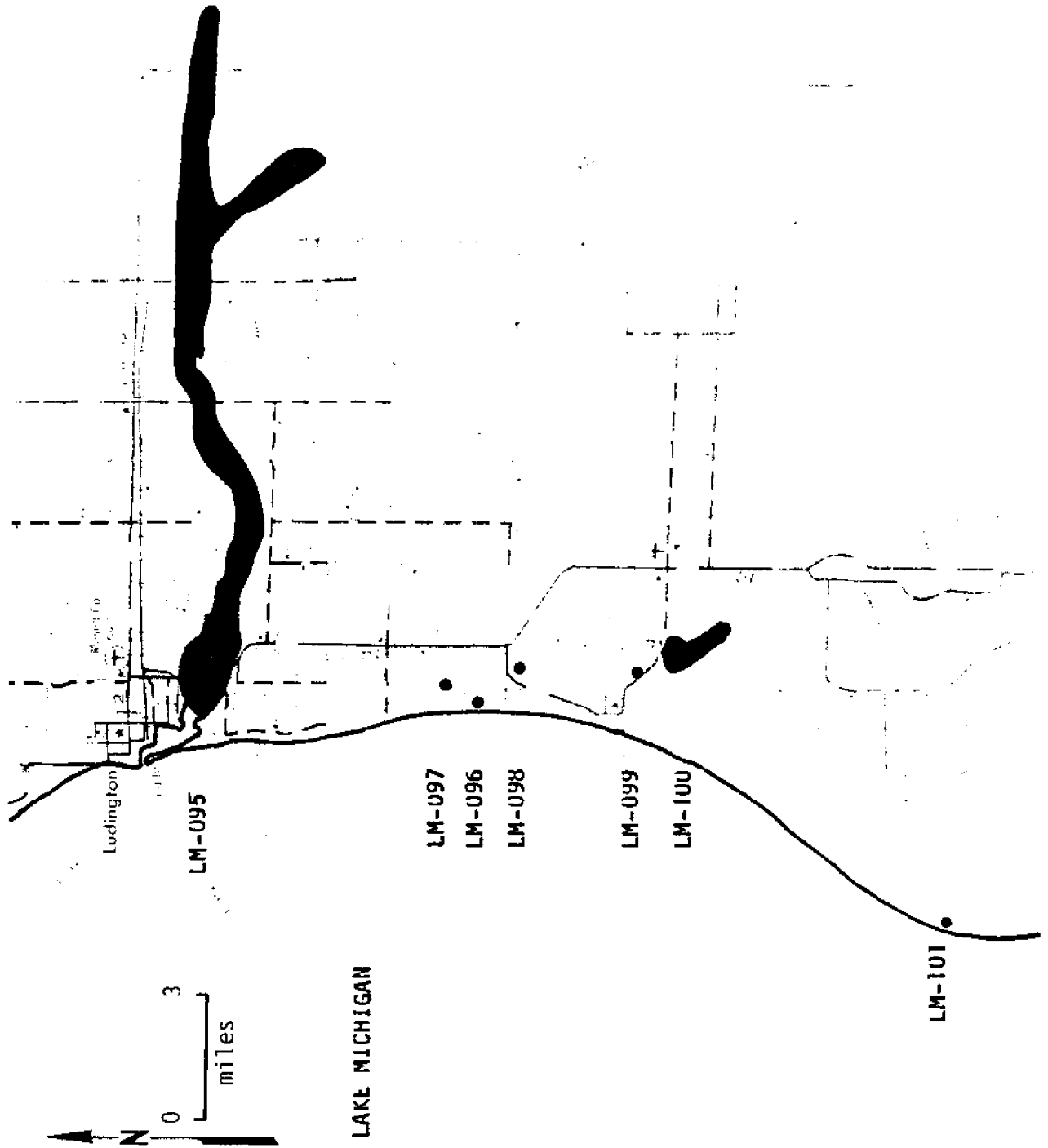


Figure 4-2. Lake Section 4 - Ludington Area
-255-

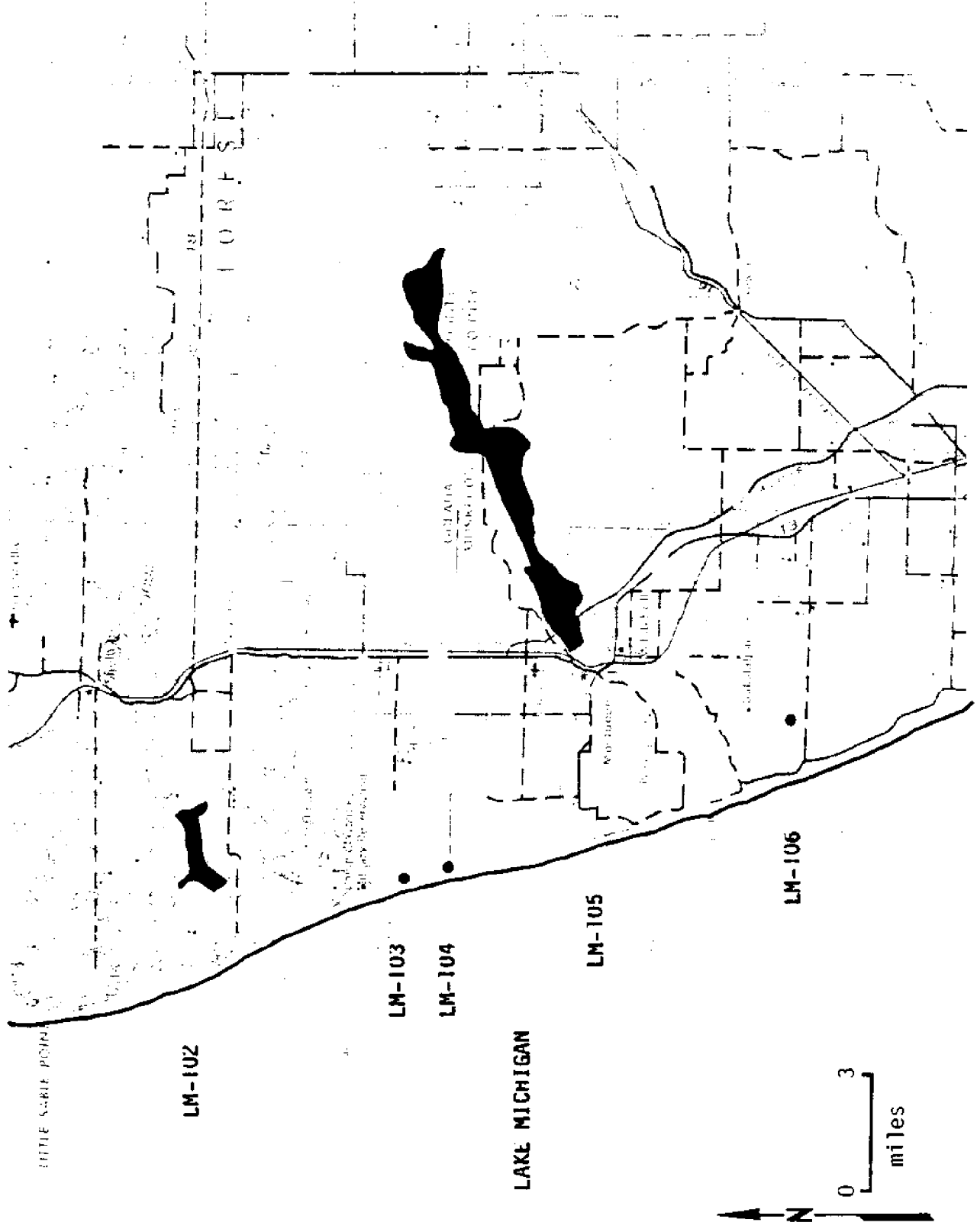


Figure 4-3. Lake Section 4 - Little Sable Point Area
-256-

Table 4-1. Location, Acreage, and Classification of Wetlands
in Lake Section 4

Wetland Number	Wetland	Latitude	Longitude	Acreage	Classification ^a
076	Portage Lake Wetland	44°22'30"	86°14'02"	19	L
	BAR LAKE WETLAND COMPLEX				
077	Bar Lake Swamp	44°19'13"	86°16'38"	973	P
078	Bar Lake Wetland #1	44°17'40"	86°19'20"	19	L
079	Bar Lake Wetland #2	44°18'10"	86°16'50"	194	L
080	Manistee River Wetland	44°15'30"	86°15'00"	9156	R
081	Little Manistee River Wetland	44°12'30"	86°16'00"	243	R
082	Filer/Grant Townships Wetlands	44°10'30"	86°23'00"	146	P
083	Big Sable Point Wetland	44°02'40"	86°30'40"	68	P
084	Rupert Bayou Wetland	44°04'40"	86°27'30"	272	L
	HAMLIN LAKE AREA WETLAND COMPLEX				
085	Hamlin Lake Wetland #1	44°04'45"	86°24'40"	19	L
086	Hamlin Lake Wetland #2	44°04'30"	86°19'25"	10	L
087	Big Sable River Wetland	44°05'10"	86°21'45"	350	L,R
088	Hamlin Lake Wetland #3	44°03'45"	86°23'35"	10	L
	HAMLIN LAKE WETLAND COMPLEX				
089	Hamlin Lake Wetland #4	44°03'48"	86°27'10"	39	L
090	Hamlin Lake Wetland #5	44°03'28"	86°27'10"	68	L
091	North Bayou Wetland	44°02'40"	86°25'58"	175	P,L
092	Middle Bayou Wetland	44°01'30"	86°26'30"	29	P,L
093	South Bayou Area Wetland	44°30'00"	86°27'42"	Drained	
094	Piney Ridge Area Wetland	44°01'30"	86°28'20"	107	L
095	Pere Marquette River Wetland	43°55'00"	86°20'00"	6256	R
	BASS LAKE WETLAND COMPLEX				
096	Kibby Creek Area Wetland	43°50'33"	86°24'55"	19	L
097	Bass Lake Wetland #1	43°49'50"	86°25'35"	10	R
098	Bass Lake Wetland #2	43°48'40"	86°24'50"	136	R
099	Pentwater Lake Wetland	43°46'18"	86°24'35"	29	P
100	Pentwater River Wetland	43°45'30"	86°24'15"	272	R
101	Richmonds Inlet Wetland	43°42'11"	86°30'17"	10	P
102	Stony Creek Wetland	43°34'20"	86°27'30"	389	L,R
103	Claybanks Township Wetland	43°29'35"	86°27'35"	19	P
104	Flower Creek Wetland	43°28'25"	86°27'17"	78	R
105	White River Wetland	43°27'00"	86°17'19"	3902	R
106	Duck Lake Wetland	43°20'40"	86°22'35"	19	L

^a P=palustrine
L=lacustrine
R=riverine

PORTAGE LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 076

Setting

Portage Lake Wetland is located near the eastern shore of Lake Michigan in Manistee County, Michigan. The wetland is situated on the north shore of Portage Lake, 1.5 miles northwest of the community of Onekama. Although Portage Lake Wetland lies 1.2 miles from the Lake Michigan shoreline, it is included in this study because it is contiguous with Portage Lake, which is influenced by the level of Lake Michigan. Portage Lake was probably a bay of Lake Michigan at one time, but the action of wind and waves has caused the development of a sand and gravel bar which now separates it from Lake Michigan. The sand and gravel bar is now bisected by a boat canal. Portage Lake Wetland is not forested, but does feature shrubs and emergent vegetation. The wetland is a Lacustrine System and occupies a low site (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan State Department of Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

Topography

The total relief of Portage Lake Wetland is 8 feet; wetland elevations range from 580 to 588 feet above sea level, 0 to 8 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a low lacustrine plain; inland elevations rise rapidly to several hundred feet above lake level. High-relief sand dunes are common nearby. The shoreline near Portage Lake Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff.

Surficial Geology

The surficial geology of Portage Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along much of the shoreline of Portage Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Portage Lake Wetland is Muck. The surface layer of Muck is usually dark and loamy and consists of organic material, with coarse and fibrous, less decomposed matter below the surface. Muck is a poorly drained soil generally found in depressions and along waterways (Wheeting and Bergquist, 1926).

Hydrology

There are no streams flowing through Portage Lake Wetland, but the wetland is located adjacent to Portage Lake (U.S.G.S. quadrangle map, Onekama,

Michigan, 1956). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Portage Lake Wetland.

Climate

The closest weather station providing climatic data for Portage Lake Wetland is located in Frankfort, Michigan. In 1975, the average monthly temperature was 45.7°F, the average daily low for January was 19.1°F and the average daily high in July was 77.5°F. The average annual precipitation is 36.08 inches, with a mean monthly precipitation of 2.71 inches in January and 1.99 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on November 24 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Portage Lake Wetland (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 076

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Portage Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Portage Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Portage Lake Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Portage Lake Wetland. The literature search

yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to W. L. Gelston (personal communication), Portage Lake now supports a resident canada goose (Branta canadensis) population which originated from the Betsie River flock.

Appendixes D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Portage Lake Wetland.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Portage Lake Wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Portage Lake Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Portage Lake Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 076

Population

Portage Lake Wetland is located in Onekama Township of Manistee County, Michigan. The county is sparsely populated, having a density of 37 persons per square mile. Table 4-2 indicates that Manistee County and Onekama Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Manistee County is expected to undergo continued rapid population growth.

Table 4-2. Population Data for the Vicinity of Portage Lake Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Onekama Township	1,205	6.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Portage Lake Wetland is rural open space. The surrounding area is primarily agricultural, with residential development, including the towns of North Point and Onekama, along the shoreline of Portage Lake. A secondary highway lies a short distance to the north of Portage Lake Wetland, and an access road lies slightly to the west (U.S.G.S. quadrangle map, Onekama, Michigan, 1956; Michigan Department of State Highways and Transportation aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetland lies within the unincorporated area of Portage Park. While detailed ownership records of this area are unavailable, it is assumed that the wetland is under private ownership (Rockford Map Publishers, Inc., 1974).

Portage Lake Wetland may face high development pressures owing to a proposed plan for a sewer system around the shoreline of the lake. The impending installation of the sewer system has led to land speculation along the lake shoreline and indicates that extensive development may be expected (W. Gelston, personal communication).

Recreation

There are no known state or federal recreational facilities in the vicinity of Portage Lake Wetland.

Mineral, Energy, and Forest Resources

Portage Lake Wetland lies within an area of Silurian salt deposits underlain by Devonian salt, but there are no operations in or near the wetland exploiting this resource (Gere, 1977). This area is considered favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975); a number of oil and gas pools, and wells utilizing these pools, are located in a band extending from south of Portage Lake to the northeast. There is a dry hole just northeast of the wetland (Michigan Geological Survey, 1977 and 1978). Three active sand and gravel operations lie to the north and west of the wetland (Michigan Department of State Highways and Transportation aerial photograph, 1973). There are no coal resources in Portage Lake Wetland (Smith, 1915), nor

are there any significant forest resources (Indiana University, environmental Systems Application Center aerial reconnaissance, 1978).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Portage Lake Wetland (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956, and Onekama, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Portage Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Portage Lake Wetland nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 076

The literature search identified no on-going or impending research projects pertaining to Portage Lake Wetland.

BAR LAKE WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 077-079

Setting

The Bar Lake Wetland Complex, comprised of Bar Lake Swamp and Bar Lake Wetlands #1 and #2, is located near the eastern shoreline of Lake Michigan in Manistee County, Michigan. The distances of these wetlands relative to the lakeshore and the City of Manistee are indicated in Table 4-3.

Table 4-3. Location of Individual Wetlands in the Bar Lake Wetland Complex

	Distance to lakeshore (feet)	Distance to Manistee, Michigan
Bar Lake Swamp	350	4.5 miles north
Bar Lake Wetland #1	350	2.7 miles north
Bar Lake Wetland #2	3000	2.9 miles northeast

Bar Lake Swamp is located to the north of Bar Lake. A perennial stream and two areas of open water lie within this wetland, and a line of low sand dunes separates it from Lake Michigan. Bar Lake Swamp is a Palustrine System and occupies a low, partially wooded site. Bar Lake Wetland #1 is located near the point at which Bar Lake flows into Lake Michigan. This wetland is contiguous with Bar Lake, and is a low, non-wooded Lacustrine System. Bar Lake Wetland #2, a low, partially wooded Lacustrine System, is contiguous with the eastern end of Bar Lake (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956).

Topography

Elevations within the Bar Lake Wetland Complex range from 581 to 600 feet above sea level, 1 to 20 feet above the approximate mean elevation of Lake Michigan. The elevation and total relief of the individual wetlands in the wetland complex are shown in Table 4-4.

Table 4-4. Elevations and Total Relief of Individual Wetlands in the Bar Lake Wetland Complex

	Minimum elevation (feet) ^a	Maximum elevation (feet) ^a	Total relief (feet)
Bar Lake Swamp	587	600	13
Bar Lake Wetland #1	581	590	9
Bar Lake Wetland #2	581	595	14

^a Elevations measured in feet above sea level; approximate mean elevation of Lake Michigan is 580 feet above sea level.

The Bar Lake Wetland Complex is situated on a narrow lacustrine plain surrounded by rolling morainal topography. Sand dunes are common nearby. The shoreline near the wetland complex is described by the Great Lakes Basin Commission (1975) as an erodible high bluff.

Surficial Geology

The surficial geology of Bar Lake Swamp is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along portions of the shoreline southwest of Portage Lake (Martin, 1957; Dorr and Eschman, 1976).

The surficial geology of Bar Lake Wetlands #1 and #2 is characterized by moraines. Moraine formations are materials deposited by glacial action, and usually consist of till. Moraines are found primarily in the inland area north of the city of Manistee (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are two soil types present in the Bar Lake Wetland Complex: Muck in the middle of Bar Lake Swamp, and Saugatuck loamy sand in the northern and southern parts of the wetland. The soil type in Bar Lake Wetlands #1 and #2 is Muck (Wheeting and Bergquist, 1926).

The surface layer of Saugatuck loamy sand consists of dark grayish brown to black vegetable mold underlain with sand and organic matter. This soil is poorly drained and has low natural fertility. The surface layer of Muck is usually dark and loamy and consists of organic material, with coarse and fibrous, less decomposed matter below the surface. This soil is poorly drained and is generally found in depressions and along waterways (Wheeting and Bergquist, 1926).

Hydrology

An unnamed perennial stream flows through Bar Lake Swamp, south to Bar Lake. Two small unnamed lakes are adjacent to Bar Lake Swamp; one lies to the northeast and the other to the northwest. Bar Lake Wetland #1 is adjacent to the western end of Bar Lake, and Bar Lake Wetland #2 is adjacent to the eastern end of the lake. No streams flow through Bar Lake Wetlands #1 and #2 (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Bar Lake Swamp and Bar Lake Wetlands #1 and #2.

Climate

The closest weather station providing climatic data for Portage Lake Wetland is located in Frankfort, Michigan. In 1975, the average monthly temperature was 45.7°F, the average daily low for January was 19.1°F and the average daily high in July was 77.5°F. The average annual precipitation is 36.08 inches, with a mean monthly precipitation of 2.71 inches in January and 1.99 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on November 24 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Bar Lake Wetland Complex (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978).

BIOTIC SETTING

LM 077-079

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of the Bar Lake Wetland Complex.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in the Bar Lake Wetland Complex.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in the Bar Lake Wetland Complex.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Bar Lake Wetland Complex.

The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Bar Lake Wetland Complex.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these three wetlands.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the three wetlands comprising the Bar Lake Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Bar Lake Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

Population

The Bar Lake Wetland Complex is located in Manistee Township of Manistee County, Michigan. The county is sparsely populated, having a density of 37 persons per square mile. Table 4-5 indicates that Manistee County experienced a rapid rate of population growth between 1970 and 1975. Manistee Township grew slowly during the same time period. Projections for 1990 indicate that Manistee County is expected to undergo continued rapid population growth.

Table 4-5. Population Data for the Vicinity of the Bar Lake Wetland Complex

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Manistee Township	2,946	2.5	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Bar Lake Swamp and Bar Lake Wetlands #1 and #2 is rural open space, with some residential development in the southwest corner of Bar Lake Swamp. The surrounding area is primarily agricultural, but residential development is present along the shores of Lake Michigan and Bar Lake in the southwest portion of the wetland complex. Access roads are located near Bar Lake Wetlands #1 and #2, and are within and near Bar Lake Swamp. A bridge is located to the west of Bar Lake Wetland #1 (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973; Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). The wetlands are under private ownership (Rockford Map Publishers, Inc., 1974).

The immediate presence of residential and agricultural land use surrounding the wetlands, coupled with private ownership and the presence of energy resources, may reflect moderate to high development pressures.

Recreation

There are no known state or federal recreational facilities in Bar Lake Swamp or Bar Lake Wetlands #1 and #2.

Mineral, Energy, and Forest Resources

Bar Lake Swamp and Bar Lake Wetlands #1 and #2 are within an area of Silurian salt deposits underlain by Devonian salt, but there are no operations in or near the wetlands exploiting this resource (Gere, 1977). Five oil wells and three dry holes are located within Bar Lake Swamp; another oil well is located just south of the wetland. Wells also lie on the western periphery of Bar Lake Wetland #2 and south of Bar Lake Wetland #1 (Michigan Geological Survey, 1978). No coal resources are present in or near the wetlands (Smith, 1915). The sand dunes north of the city of Manistee have been leveled by a private sand-mining company (Northwest Michigan Regional Planning and Development Commission, 1977).

Bar Lake Swamp and Bar Lake Wetland #2 are partially wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978), but it was not determined through the literature search whether these wooded areas are used for commercial production. There are no significant forest resources in Bar Lake Wetland #1.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Bar Lake Swamp and Bar Lake Wetlands #1 and #2 (U.S.G.S. quadrangle map, Bar Lake, Michigan, 1956).

Pollution Sources

There are no NPDES permit holders adjacent to Bar Lake Swamp and Bar Lake Wetlands #1 and #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Bar Lake Swamp and Bar Lake Wetlands #1 and #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 077-079

The literature search identified no on-going or impending research projects pertaining to Bar Lake Swamp and Bar Lake Wetlands #1 and #2.

MANISTEE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 080

Setting

Manistee River Wetland is located in the flood plain of the Manistee River, 0.5 mile from the eastern shoreline of Lake Michigan and 0.5 mile west of the community of Manistee. The wetland lies within Manistee County, Michigan, and the Manistee National Forest. Manistee River Wetland is included in this study because it is contiguous with the east side of Manistee Lake, which is at the same elevation as Lake Michigan. The wetland extends more than 14 miles inland. A number of streams flow into Manistee River Wetland, and nearly the entire length of the wetland features abandoned meanders of the Manistee River. Most of the wetland is wooded. Manistee River Wetland is a Lower Perennial River System (U.S.G.S. quadrangle maps, Bar Lake, Michigan, 1956, and Onekama, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Manistee River Wetland is 40 feet; wetland elevations range from 580 to 620 feet above sea level, 0 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland is situated in a narrow and generally flat outwash plain, but topography a short distance to the north and to the south of the wetland is more varied. The shoreline near Manistee River Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff.

Surficial Geology

The surficial geology of Manistee River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along most of the western part of the Manistee River Basin (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Manistee River Wetland is Newton sand, which has a surface layer of very dark gray, coarse-textured organic and mineral material. Most of the organic matter is found in the upper layer; the subsurface is comprised of almost white, medium to coarse sand. Newton sand is poorly drained (Wheeting and Bergquist, 1926).

Hydrology

Manistee River Wetland is located on both sides of the Manistee River, which flows west through the wetland to Manistee Lake. A tributary of the Manistee River, Bear Creek, flows through the northern arm of the wetland, which lies within the flood plain of the river and its tributaries. There are eleven

named tributaries joining the Manistee River: Blacksmith Bayou, Deer Lake Bayou, Sergeant Bayou, Borski Bayou, Browns Bayou, Jenkins Bayou, Anderson Bayou, Claybank Bayou, Tatches Bayou, Highpoint Bayou, and Peters Bayou. In addition, there are many unnamed tributaries to these bayous and to the Manistee River (U.S.G.S. quadrangle maps, Bar Lake, Michigan, 1956; Onekama, Michigan, 1956). The drainage area of the Manistee River is 1,780 square miles, with a mean discharge of 3,370 cubic feet per second in April and 2,047 cubic feet per second in November. Water quality data for the Manistee River one mile upstream from the river mouth are presented in Table 4-6. Additional water quality data are available from the U.S. Geological Survey, Water Resources Division (1977).

Table 4-6. Water Quality Data for the Manistee River Sampled One Mile Upstream from the River Mouth^a

	pH	Temp. (°C)	D. O. (mg/l)	Alkal. CaCO ₃ (mg/T)	Suspended solids (mg/l)	Nitrogen (mg/l)
Nov. 5, 1975	8.0	10.5	9.8	164	1	2.5
April 7, 1976	7.6	7.0	11.0	112	12	2.3

^a U.S. Geological Survey, Water Resources Division, 1977

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Manistee River Wetland.

Climate

The closest weather station providing climatic data for Manistee River Wetland is located in Manistee, Michigan. In 1975, the average monthly temperature was 47.7°F, the average daily low for January was 19.4°F and the average daily high in July was 82.2°F. The average annual precipitation is 30.92 inches, with a mean monthly precipitation of 2.02 inches in January and 2.72 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Manistee River Wetland (U.S.G.S. quadrangle maps, Bar Lake, Michigan, 1956; Onekama, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photographs, 1973).

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Manistee River Wetland.

Fish

Test-netting results in the 1950's revealed the presence of the following wetland-related species in Manistee Lake: northern pike (*Esox lucius*), bowfin (*Amia calva*), brown bullhead (*Ictalurus nebulosus*), yellow bullhead (*Ictalurus natalis*), white sucker (*Catostomus commersoni*), redhorse (*Moxostoma* sp.), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), rock bass (*Ambloplites rupestris*), bluegill (*Lepomis macrochirus*), pumpkinseed (*Lepomis gibbosus*), warmouth sunfish (*Lepomis gulosus*), black crappie (*Pomoxis nigromaculatus*), walleye (*Stizostedion vitreum*), yellow perch (*Perca flavescens*), johnny darter (*Etheostoma nigrum*), carp (*Cyprinus carpio*), bluntnose minnow (*Pimephales notatus*), emerald shiner (*Notropis atherinoides*), common shiner (*Notropis cornutus*), and banded killifish (*Fundulus diaphanous*) (Taube, 1958). Other species found in the lake (e.g. alewife *Alosa pseudoharengus* and salmonids) were probably associated very little with Manistee River Wetland. All game species appeared to be abundant and supported a popular sport fishery. There was concern that industrial and municipal water pollution was destroying the habitat and recreational fishery of Manistee Lake. Growth rates of several species were reported (Taube, 1958). Although it was not specifically stated, it is probable that Manistee River Wetland was a major spawning area for many species, particularly esocids. More current, but unpublished, records of the fish fauna of this important wetland adjacent to a popular recreational lake probably exist in the files of the Michigan Department of Natural Resources. A search of the literature provided no site-specific information pertaining to spawning and hatching areas, seasonal locations and abundance, life histories, commercial use, or food sources of the fish populations in Manistee River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Manistee River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Manistee River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

A portion of Manistee River Wetland was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance, which identified inadequately protected high quality waterfowl areas (Martz, 1976). Manistee River Wetland, the western section of which is incorporated in the Manistee River State Game Area, is the second largest wetland area on the west side of the Lower Peninsula, and is a major local nesting and staging area. Estimated waterfowl production and migration data for the wetland are presented in Table 4-7.

The most commonly observed waterfowl in the area are mallards (Anas platyrhynchos), black ducks (A. rubripes), blue-winged teal (A. discors), green-winged teal (A. crecca), wood ducks (Aix sponsa), Canada geese (Branta canadensis), American coots (Fulica americana), and common gallinules (Gallinula chloropus) (Michigan Department of Natural Resources, undated). According to the Michigan Department of Natural Resources, a moderate number of species feed, nest, and migrate through the area and include such game species as snipe (Capella gallinago), woodcock (Philohela minor), sora (Porzana carolina), and Virginia rails (Rallus limicola). Shorebirds, raptors, and songbirds also utilize the area. Ruffed grouse (Bonasa umbellus) are in fair abundance in the drier areas, particularly in years when wild grapes and dogwoods bear well.

Use of Manistee River Wetland by wildlife, including waterfowl, is greatest when water flows over the floodplain, as occurs seasonally in spring or fall and during high water years. Waterfowl hunting is one of the primary management and public uses of the area.

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Manistee River Wetland. The literature search provided no site-specific information pertaining to commercial use, health, life histories, or major food sources of the birds utilizing Manistee River Wetland.

Mammals

Manistee River Wetland is considered exceptional habitat for muskrat (Ondatra zibethicus) (Jaworski and Raphael, 1978). However the literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting this wetland.

Table 4-7. Estimated Waterfowl Production and Migrational Use of Manistee River Wetland^a

Species	Production		Migration		Avg duration (no. weeks)
	Avg density (prs/sq mi)	Avg young/ wetland acre	Avg peak population	Avg fall population	
DUCKS					
mallard	50	1.50	2500	600	7
black duck	10	.15	250	200	8
green-winged teal	2	.03	200	100	6
blue-winged teal	25	.39	500	350	5
wood duck	13	.20	1000	300	6
Total Ducks	100	2.27	4450	1550	
GEESE					
Canada goose	0	0	500	100	
Total Geese	0	0	500	100	
Total Anatidae	100	2.27	4950	1650	

^aMartz (1976)

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Manistee River Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Manistee River Wetland is good for production of waterfowl. However, four NPDES permit holders are located near the wetland and the effluent from these plants may have some effect on its health.

CULTURAL SETTING

LM 080

Population

Manistee River Wetland is located within Manistee, Brown, and Dickson Townships of Manistee County, Michigan. The county is sparsely populated, having a density of 37 persons per square mile. Table 4-8 indicates that Manistee County, Brown Township, and Dickson Township all experienced a rapid rate of population growth between 1970 and 1975, but Manistee Township population increased slowly during the same time period. Projections for 1990 indicate that Manistee County is expected to undergo continued rapid population growth.

Table 4-8. Population Data for the Vicinity of Manistee River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Manistee Township	2,946	2.5	--
Brown Township	742	7.7	--
Dickson Township	773	23.3	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Manistee River Wetland is rural open space. The western portion of the wetland is fringed by areas of residential and commercial development, including the communities of Parkdale just north of the wetland, East Lake to the south, and Manistee across Manistee Lake from the wetland. Land uses in the area surrounding the wetland are less intensive upriver, giving way to scattered residences and to agricultural and other rural open space uses.

A number of secondary highways, access roads, and rail lines lie adjacent to and within Manistee River Wetland. Manistee-Blacker Airport is adjacent to the northern portion of the wetland, and a dam on the Manistee River is located more than a mile upstream from the eastern end of the wetland (U.S.G.S. quadrangle maps, Bar Lake, Michigan, 1956; Onekama, Michigan, 1956; Agricultural Stabilization and Conservation Service aerial photograph, 1973). The eastern portion of Manistee River Wetland is mostly under the ownership of the State of Michigan. The western portion of the wetland is privately owned, primarily by the Consumers Power Company (David J. Warner, Northwest Michigan Regional Planning and Development Commission, personal communication).

Development pressures for Manistee River Wetland are likely to be high. This wetland faces long term development pressures, with development expected in five or more years. Infringement upon this wetland is expected from private development, oil and gas extraction, and airport expansion (Martz, 1976).

Recreation

The eastern portion of Manistee River Wetland is located within the Manistee River State Game Area. Primary public uses of this area are waterfowl and small game hunting and fishing (Michigan Department of Natural Resources, undated).

Mineral, Energy, and Forest Resources

Manistee River Wetland lies within an area of Silurian salt deposits underlain by Devonian salt. There are two operations within the city of Manistee utilizing this resource (Gere, 1977). Although there are a number of dry holes within the wetland, there are no oil and gas wells. However, oil and gas wells are located in the area north of the wetland (Michigan Geological Survey, 1978); the area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975). There are no coal resources near the wetland (Smith, 1915). An active sand and gravel operation is located just south of the wetland in the Claybank Creek area near Claybank Lake (Michigan Department of State Highways and Transportation aerial photograph, 1973).

Most of Manistee River Wetland is wooded and lies within Manistee National Forest (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). It was not determined through the literature search whether any of this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Manistee River Wetland (U.S.G.S. quadrangle maps, Bar Lake, Michigan, 1956, and Onekama, Michigan, 1956).

Pollution Sources

Four NPDES permit holders are located near the shore of Manistee Lake in Manistee, across from the western edge of Manistee River Wetland. Silvert

Brothers Transit Mix Company discharges into Manistee Lake, and the Laman Asphalt and Paving Company discharges into Manistee Lake via a pond. Stancoff Car Wash discharges into a storm sewer. The type of discharge from these permit holders is unknown. Martin Marietta Chemicals, Incorporated, discharges process wastes into Manistee Channel (Michigan Water Quality Division, 1978). The effect of the discharge (if any) by these NPDES permit holders on Manistee River Wetland is not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Manistee River Wetland (Peebles and Black, 1976). However, two archaeological sites are present in the vicinity of the wetland. The Bear Creek site was occupied during the Late Woodland period as a summer fishing village. Excavation has revealed material indicating that the occupants had Ottawa-type cultural patterns. Riverview Cemetery is a multi-component site that was occupied during the Late Archaic and Late Woodland periods. Artifacts from burials at the site are representative of the old Copper Culture of the Late Archaic period (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 080

The literature search identified no on-going or impending research projects pertaining to Manistee River Wetland.

LITTLE MANISTEE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 081

Setting

Little Manistee River Wetland is located 3.7 miles from the eastern shoreline of Lake Michigan in Manistee County, Michigan, 0.3 mile southeast of Filer City and adjacent to the community of Stronbach. Little Manistee River Wetland is included in this study because it is contiguous with Manistee Lake, which has the same elevation as Lake Michigan. The Little Manistee River flows through the wetland and into Manistee Lake, and the wetland is situated within the river's floodplain. The eastern portion of Little Manistee River Wetland lies within the Manistee National Forest, but only a small portion of the wetland is wooded. Little Manistee River Wetland is a Low Perennial Riverine System (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Little Manistee River Wetland is 20 feet; wetland elevations range from 580 to 620 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. Little Manistee River Wetland lies on a narrow and generally flat outwash plain, but topography at a short distance to the north and to the south of the wetland is more varied. The shoreline near Little Manistee River Wetland is described by the Great Lakes Basin Commission (1975) as an erodible low bluff.

Surficial Geology

The surficial geology of Little Manistee River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found in the coastal areas to the east of Manistee Lake (Martin, 1957; Dorr and Eschman, 1977).

Soils

The soil type in Little Manistee River Wetland is Muck. The surface layer of Muck is usually dark and loamy and consists of organic material, with coarse and fibrous, less decomposed matter below the surface. This soil is poorly drained and is generally found in depressions and along waterways (Wheeting and Bergquist, 1926).

Hydrology

The Little Manistee River flows west through Little Manistee River Wetland. The western end of the wetland borders Lake Manistee (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). Manistee Lake has substandard water quality owing to chloride and other dissolved solids, low levels of dissolved oxygen, and high levels of nutrients (Great Lake Basin Commission, 1975). The effect of the lake water on the wetland is not known.

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Little Manistee River Wetland.

Climate

The closest weather station providing climatic data for Little Manistee River Wetland is located in Manistee, Michigan. In 1975, the average monthly temperature was 47.7°F, the average daily low for January was 19.4°F and the average daily high in July was 82.2°F. The average annual precipitation is 30.92 inches, with a mean monthly precipitation of 2.02 inches in January and 2.72 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Little Manistee River Wetland (U.S.G.S. quadrangle maps, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 081

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Little Manistee River Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Little Manistee River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Little Manistee River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Little Manistee River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Little Manistee River Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the three wetlands comprising the Little Manistee River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Little Manistee River Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, a plant discharges cooling water near the wetland, which may have some effect on its health.

Population

Little Manistee River Wetland is located in Stronbach Township of Manistee County, Michigan. The county is sparsely populated, having a density of 37 persons per square mile. Table 4-9 indicates that Manistee County experienced a rapid rate of population growth between 1970 and 1975. Stronbach Township, however, underwent a rapid decline in population during the same time period. Projections for 1990 indicate that Manistee County is expected to undergo continued rapid population growth.

Table 4-9. Population Data for the Vicinity of Little Manistee River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Stronbach Township	466	-13.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Little Manistee River Wetland is rural open space. The surrounding area is characterized by residential, industrial, and commercial development north of the wetland on either side of Manistee Lake (the communities of Stronbach and Filer City). Agricultural and other rural open space uses are also present in the nearby area. A rail line, secondary highways, and access roads lie adjacent to and within Little Manistee River Wetland (U.S.G.S. quadrangle maps, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973). The wetland is under industrial and private ownership (David J. Warner, Northwest Michigan Regional Planning and Development Commission, personal communication).

Development pressures for Little Manistee River Wetland are likely to be high. This wetland faces long term development pressures; infringement upon this wetland is expected from private and industrial development and oil and gas exploitation in five years or more (Martz, 1976).

Recreation

There are no known state or federal recreational facilities in the vicinity of Little Manistee River Wetland.

Mineral, Energy, and Forest Resources

Little Manistee River Wetland lies within an area of Silurian salt deposits underlain by Devonian salt, but there are no operations in or near the wetland exploiting this resource (Gere, 1977). There are no oil and gas wells in Little Manistee River Wetland, although there is a dry hole in the northern portion (Michigan Geological Survey, 1978), and the area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975). No coal resources are present in the wetland (Smith, 1915). There are a number of wells in the vicinity of the wetland formerly used for brine production (Gere, 1977; Michigan Geological Survey, 1978).

Only a small portion of Little Manistee River Wetland is wooded (Indiana University, Environmental Systems Application Center aerial reconnaissance, 1978). It was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Little Manistee River Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

The Packing Corporation of America, located in Filer City, discharges turbine, evaporator, vacuum pump, and mill cooling water into Manistee Lake northeast of the Little Manistee River Wetland (Michigan Water Quality Division, 1978). The extent and effect of the discharge (if any) by the Packing Corporation of America on Little Manistee River Wetland is not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Little Manistee River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 081

The literature search identified no on-going or impending research projects pertaining to Little Manistee River Wetland.

FILER/GRANT TOWNSHIPS WETLAND

PHYSIOGRAPHIC SETTING

LM 082

Setting

Filer/Grant Townships Wetland is located 0.1 mile from the eastern shoreline of Lake Michigan, 4.3 miles south of the city of Manistee, Michigan. The Manistee County-Mason County line bisects the wetland, which is situated in a depression landward of low coastal hills. Filer/Grant Townships Wetland is an almost completely wooded Palustrine System (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Filer/Grant Townships Wetland is 30 feet; wetland elevations range from 590 to 620 feet above sea level, 10 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland is located in a rolling morainal area which is dissected by numerous small streams. The shoreline near Filer/Grant Township Wetland is described by the Great Lakes Basin Commission (1975) as an erodible high bluff.

Surficial Geology

The surficial geology of Filer/Grant Townships Wetland is characterized by sand dunes, which are found along the lakeshore from Manistee south to Big Sable Point (Martin, 1957).

Soils

The soil type in Filer/Grant Townships Wetland is Lupton muck, which has a surface layer of dark brown to black granular organic matter containing roots; it is underlain by dark brown, well-decomposed organic matter, tree trunks, and roots. This soil is poorly drained and has moderate natural fertility (Wonser et al., 1939).

Hydrology

A short, unnamed perennial stream flows north to Lake Michigan from the northern part of Filer/Grant Townships Wetland. This stream has an intermittent tributary joining it from the east (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Filer/Grant Townships Wetland is located in Manistee, Michigan. In 1975, the average monthly temperature was 47.7°F, the average daily low for January was 19.4°F and the average daily high in July was 82.2°F. The average annual precipitation is 30.92 inches, with a mean monthly precipitation of 2.02 inches in January and 2.72 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in the vicinity of Filer/Grant Townships Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 082

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Filer/Grant Townships Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Filer/Grant Townships Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Filer/Grant Townships Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Filer/Grant Townships Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Filer/Grant Townships Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Filer/Grant Townships Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Filer/Grant Townships Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 082

Population

Filer/Grant Townships Wetland is located in Filer Township of Manistee County and Grant Township of Mason County. Both counties are sparsely populated, having densities of 37 and 46 persons per square mile, respectively. Table 4-10 indicates that between 1970 and 1975, Filer Township experienced a slow rate of population decline, but Grant Township and Manistee and Mason Counties experienced a rapid rate of population growth during the same time period. Projections for 1990 indicate that Manistee County and Mason County are expected to undergo continued rapid population growth.

Table 4-10. Population Data for the Vicinity of Filer/Grant Townships Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Filer Township	1,872	-2.6	--
Mason County	24,517	8.4	30,667
Grant Township	494	17.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Filer/Grant Townships Wetland is rural open space. The surrounding area is primarily in agricultural and other rural open space uses, with occasional residences (Agricultural Stabilization and Conservation Service aerial photograph, 1973; West Michigan Regional Planning Commission, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that development pressures are moderate.

Recreation

There are no known state or federal recreational facilities in the vicinity of Filer/Grant Townships Wetland.

Mineral, Energy, and Forest Resources

Filer/Grant Townships Wetland lies within an area of Silurian salt deposits underlain by Devonian salt. However, there are no operations in or near the wetland exploiting this resource (Gere, 1977). The area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975), but although there is a dry hole just south of the wetland, there are no active oil or gas wells (Michigan Geological Survey, 1978). There are no coal resources near Filer/Grant Townships Wetland (Smith, 1915).

Filer/Grant Townships Wetland is wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1973), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Filer/Grant Townships Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Filer/Grant Townships Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Filer/Grant Townships Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 082

The literature search identified no on-going or impending research projects pertaining to Filer/Grant Townships Wetland.

BIG SABLE POINT WETLAND

PHYSIOGRAPHIC SETTING

LM 083

Setting

Big Sable Point Wetland is located 250 feet from the eastern shoreline of Lake Michigan in Mason County, Michigan, within Ludington State Park and 3.0 miles northwest of the community of Hamlin Lake. Hamlin Lake lies inland from the wetland. Big Sable Point Wetland is a partially wooded Palustrine System situated among high-relief sand dunes (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Big Sable Point Wetland is 15 feet; wetland elevations range from 585 to 600 feet above sea level, 5 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain composed of sand dunes. The Great Lakes Basin Commission (1975) describes the shoreline near Big Sable Point Wetland as low sand dunes.

Surficial Geology

The surficial geology of Big Sable Point Wetland is characterized by sand dunes, which are found along the lakeshore from Manistee south to Big Sable Point (Martin, 1957).

Soils

The soil type for Big Sable Point Wetland is Dune sand, which consists of gray fine sand that is constantly being shifted by wind. This soil is well-drained and supports beach grass. It is generally found in areas along Lake Michigan (Wonser et al., 1939).

Hydrology

There are no streams flowing through Big Sable Point Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Big Sable Point Wetland is located in Manistee, Michigan. In 1975, the average monthly temperature was 47.7°F, the average daily low for January was 19.4°F and the average daily high in July was 82.2°F. The average annual precipitation is 30.92 inches, with a mean monthly precipitation of 2.02 inches in January and 2.72 inches in July based on the normal period from 1941-1970. The growing

season is approximately seven months long, with the last killing frost (28⁰F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Big Sable Point Wetland (U.S.G.S. quadrangle maps, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 083

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Big Sable Point Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Big Sable Point Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Big Sable Point Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Big Sable Point Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The Lake Michigan shoreline of Ludington State Park, which includes Big Sable Point Wetland, has been proposed as an environmental area (Michigan Shorelands Management Unit, 1975). Data from the Shorelands Management Unit and from Scharf et al. (1977) indicate that the Ludington State Park area is

important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the area, particularly in the spring. Hamlin Lake, situated to the east of Big Sable Point Wetland, is also known as a waterfowl concentration area during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Big Sable Point Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Big Sable Point Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Big Sable Point Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 083

Population

Big Sable Point Wetland is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-11 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-11. Population Data for the Vicinity of Big Sable Point Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Big Sable Point Wetland is rural open space, as is the land use in the surrounding area. An access road lies adjacent to Big Sable Point Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973; West Michigan Regional Planning Commission, 1975). The wetland lies within Ludington State Park and is under state ownership (Rockford Map Publishers, Inc., 1975), so development pressures are likely to be low.

Recreation

The 4,156-acre Ludington State Park is primarily known for its outstanding system of foot trails and its sandy beaches. Other activities available in the park include boating, fishing, hunting, and picnicking (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Big Sable Point Wetland lies within an area of Silurian salt deposits underlain by Devonian salt. However, there are no operations in or near the wetland exploiting this resource (Gere, 1977). The area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975), but the nearest oil and gas wells are across Hamlin Lake from the wetland (Michigan Geological Survey, 1978). There are no coal resources near Big Sable Point Wetland (Smith, 1915).

Big Sable Point Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1973). However, owing to its location in Ludington State Park, it is unlikely that this wooded area would be subject to commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Big Sable Point Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Big Sable Point Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Big Sable Point Wetland (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that two archaeological sites (20-MN-81 and 20-MN-79, of unknown culture and date) are present in the vicinity of the wetland (Peebles and Black, 1976). Further information regarding the field research and exact location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 083

The literature search identified no on-going or impending research projects pertaining to Big Sable Point Wetland.

RUPERT BAYOU WETLAND

PHYSIOGRAPHIC SETTING

LM 084

Setting

Rupert Bayou Wetland is located near the eastern shoreline of Lake Michigan in Mason County, Michigan, 3.3 miles north of the community of Hamlin. Although the wetland lies 1.1 miles inland from the Lake Michigan shoreline, it is included in this study because it is contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. Rupert Bayou Wetland is a Lacustrine System and occupies a low, partially wooded site (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Rupert Bayou Wetland is 40 feet; wetland elevations range from 580 to 620 feet above sea level, 0 to 40 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a low lacustrine plain. An area of high sand dunes is located to the west of the wetland.

Surficial Geology

The surficial geology of Rupert Bayou Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

Much of Rupert Bayou Wetland appears as open water in the soil survey for Mason County. The remaining portions of the wetland have been mapped as Greenwood peat. The surface layer of Greenwood peat consists of yellowish-brown, coarse, fibrous raw peat which is mostly organic matter. This material is underlain by peat composed of sedges, reeds, and aquatic plant materials which form a spongelike mat. Greenwood peat is a poorly drained, highly acid soil (Wonser et al., 1939).

Hydrology

There are no streams flowing through Rupert Bayou Wetland. Parts of the wetland may be covered with water during periods of heavy rain (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Wonser et al., 1939). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Rupert Bayou Wetland is located in Manistee, Michigan. In 1975, the average monthly temperature was 47.7°F, the average daily low for January was 19.4°F and the average daily high in July was 82.2°F. The average annual precipitation is 30.92 inches, with a mean monthly precipitation of 2.02 inches in January and 2.72 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 22 (National Oceanic and Atmospheric Administration, 1975).

Special Features

Areas of open water lie within the wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

BIOTIC SETTING

LM 084

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Rupert Bayou Wetland.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Rupert Bayou Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Rupert Bayou Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Rupert Bayou Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

The Ludington State Park area is important for hawk, passerine, and shorebird migrations (Scharf et al., 1977). Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contains general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Rupert Bayou Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Rupert Bayou Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Rupert Bayou Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

Population

Rupert Bayou Wetland is located in both Hamlin and Grant Townships of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-12 indicates that Mason County and Grant Township experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-12. Population Data for the Vicinity of Rupert Bayou Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--
Grant Township	494	17.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Rupert Bayou Wetland is rural open space. The surrounding area is primarily in rural open space uses, except for residential development along the north shore of Hamlin Lake just east of the wetland (Agricultural Stabilization and Conservation Service aerial photograph, 1973; West Michigan Regional Planning Commission, 1975). An access road crosses the wetland. The northern portion of the wetland lies within the Manistee National Forest and is under federal ownership; the remainder is under private ownership (Rockford Map Publishers, Inc., 1975). It can be assumed that development pressures for the federally owned portion of the wetland are low, but low to moderate pressures might be expected for the remainder of the wetland owing to the presence of shoreline residential development.

Recreation

Rupert Bayou Wetland lies adjacent to the 4,156-acre Ludington State Park, which is primarily known for its outstanding system of foot trails and its sandy beaches. Other activities available in the park include boating, fishing, hunting, and picnicking (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Rupert Bayou Wetland lies within an area of Silurian salt deposits underlain by Devonian salt. However, there are no operations in or near the wetland exploiting this resource (Gere, 1977). The area is considered to be favorable for oil and gas field discoveries (Great Lakes Basin Commission, 1975), but although there are a number of oil and gas wells in the area east of Hamlin Lake, there are no wells in the immediate vicinity of the wetland (Michigan Geological Survey, 1978). There are no coal resources in or near the wetland (Smith, 1915).

Rupert Bayou Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1973). It was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Rupert Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Rupert Bayou Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Rupert Bayou Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 084

The literature search identified no on-going or impending research projects pertaining to Rupert Bayou Wetland.

HAMLIN LAKE AREA WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 085-086

Setting

The Hamlin Lake Area Wetland Complex, comprised of Hamlin Lake Wetlands #1 and #2, is located near the eastern shoreline of Lake Michigan in Mason County, Michigan. Hamlin Lake Wetland #1 lies four miles northeast of the community of Hamlin Lake and 2.5 miles inland from the Lake Michigan shoreline. Hamlin Lake Wetland #2 is situated 4.1 miles northeast of the community of Hamlin Lake and 2.9 miles inland. These wetlands are included in this study because they are contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. Hamlin Lake Wetlands #1 and #2 are wooded, Lacustrine Systems (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

The total relief of Hamlin Lake Wetlands #1 and #2 is 20 feet; elevations of both wetlands range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetlands lie on a lacustrine plain surrounded by rolling morainal topography.

Surficial Geology

The surficial geology of Hamlin Lake Wetlands #1 and #2 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Hamlin Lake Wetlands #1 and #2 is Rifle peat. The surface layer of this soil consists of brown or dark-brown organic matter, including partly decomposed and well decomposed wood and leaf material. Below this layer, brown, partially decomposed fibrous material is found, derived mainly from aquatic plants (Wonser et al., 1939).

Hydrology

An unnamed intermittent stream enters Hamlin Lake Wetland #1 from the north. No streams flow through Hamlin Lake Wetland #2. Both wetlands are adjacent to Hamlin Lake (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in these wetlands.

Climate

The closest weather station providing climatic data for the Hamlin Lake Area Wetland Complex is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Hamlin Lake Area Wetland Complex (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 085-086

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Hamlin Lake Wetlands #1 and #2.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Hamlin Lake Wetlands #1 and #2.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity,

food sources, or relationship to water levels of the invertebrates present in Hamlin Lake Wetlands #1 and #2.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetlands #1 and #2. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetlands #1 and #2. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these wetlands.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the two wetlands comprising the Hamlin Lake Area Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Hamlin Lake Area Wetlands Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

Population

Hamlin Lake Wetlands #1 and #2 are located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-13 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-13. Population Data for the Vicinity of Hamlin Lake Wetlands #1 and #2

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--
Grant Township	494	17.9	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Hamlin Lake Wetlands #1 and #2 and in the surrounding area is rural open space. An access road is located between Hamlin Lake Wetlands #1 and #2 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Planning Commission, 1975). The wetlands are under private ownership (Rockford Map Publishers, Inc., 1975), but their location suggests that development pressures are low to moderate.

Recreation

There are no known state or federal recreational facilities in Hamlin Lake Wetlands #1 and #2.

Mineral, Energy, and Forest Resources

Hamlin Lake Wetlands #1 and #2 are within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the vicinity of the wetlands contains isolated oil and gas pools, there are presently no operations of this nature near the wetlands (Great Lakes Basin Commission, 1975;

Michigan Geological Survey, 1977). There are no known coal deposits in the wetlands (Smith, 1915).

Hamlin Lakes Wetlands #1 and #2 are wooded (Agricultural Stabilization and Conservation Service aerial photograph 1972), but it was not determined through the literature search whether these wooded areas are subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Hamlin Lake Wetlands #1 and #2 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Hamlin Lake Wetlands #1 and #2 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Hamlin Lake Wetlands #1 and #2, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 085-086

The literature search identified no on-going or impending research projects pertaining to Hamlin Lake Wetlands #1 and #2.

BIG SABLE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 087

Setting

Big Sable River Wetland is located at the head of Hamlin Lake, near the eastern shoreline of Lake Michigan in Mason County, Michigan, 5.5 miles northeast of the community of Hamlin Lake. The wetland is 4.7 miles east of the Lake Michigan shoreline, but it is included in this study because it is contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. The northeastern portion of the wetland is wooded; the lower portion of the wetland, which is adjacent to Hamlin Lake, is non-wooded. Big Sable River Wetland is both a Lacustrine and Lower Perennial Riverine System and occupies a low site within the Manistee National Forest (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

The total relief of Big Sable River Wetland is 20 feet; wetland elevations range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain surrounded by rolling morainal topography.

Surficial Geology

The surficial geology of Big Sable River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the western end of the Big Sable River and the Hamlin Lake shoreline (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type for Big Sable River Wetland is Houghton muck. The surface layer of Houghton muck is comprised of brown to black, fibrous, loose granular matter. This well decomposed organic material includes some roots and is underlain with decomposed sedges and grasses. Houghton muck is generally found in old lake beds (Wonser et al., 1939).

Hydrology

The Big Sable River flows southwest through Big Sable River Wetland, forming a delta where it enters Hamlin Lake. Davis Creek and an unnamed intermittent stream enter the wetland from the east. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Big Sable River Wetland.

Climate

The closest weather station providing climatic data for Big Sable River Wetland is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Big Sable River Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 087

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Big Sable River Wetland.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Big Sable River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Big Sable River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Big Sable River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Big Sable River Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Big Sable River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Big Sable River Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

Population

Big Sable River Wetland is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-14 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-14. Population Data for the Vicinity of Big Sable River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Big Sable River Wetland is rural open space. The surrounding area is characterized by agricultural and other rural open space uses. Access roads lie to the east and to the west of Big Sable River Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Planning Commission, 1975). The wetland is under mixed federal and private ownership (Rockford Map Publishers, Inc., 1975), but the predominance of federal ownership may indicate that this wetland is subject to low development pressures.

Recreation

There are no known state or federal recreational facilities in Big Sable River Wetland.

Mineral, Energy, and Forest Resources

Big Sable River Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of Big Sable River Wetland contains isolated oil and gas pools, there are presently no operations

of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1975). There are no known coal deposits in the wetland (Smith, 1915).

Big Sable River Wetland is partially wooded and lies within the Manistee National Forest. Specific information on the commercial value of forest resources in this wetland and operations for harvesting these resources was not identified through the literature search. However, any harvesting of timber would be subject to Forest Service guidelines on the management of wetland resources (U.S. Forest Service, 1976).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Big Sable River Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Big Sable River Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Big Sable River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 087

The literature search identified no on-going or impending research projects pertaining to Big Sable River Wetland.

HAMLIN LAKE WETLAND #3

Setting

Hamlin Lake Wetland #3 is located near the eastern shoreline of Lake Michigan in Mason County, Michigan, four miles northeast of the community of Hamlin Lake. Although it lies 3.9 miles from the Lake Michigan shoreline, Hamlin Lake Wetland #3 is included in this study because it is adjacent to Hamlin Lake, which is influenced by the water levels of Lake Michigan. The wetland is situated on the east side of a small inlet of Hamlin Lake, and an intermittent stream flows into Hamlin Lake to the south of the wetland. Hamlin Lake Wetland #3 is a Lacustrine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973).

Topography

The total relief of Hamlin Lake Wetland #3 is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to rolling.

Surficial Geology

The surficial geology of Hamlin Lake Wetland #3 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Hamlin Lake Wetland #3 is Houghton muck. The surface layer of Houghton muck is comprised of brown to black, fibrous, loose granular matter. This well decomposed organic material includes some roots and is underlain with fibrous material, such as sedges and grasses, that is also well decomposed. Houghton muck is generally found in old lake beds (Wonser et al., 1939).

Hydrology

An unnamed intermittent stream flows into Hamlin Lake Wetland #3 from the adjacent upland. Hamlin Lake Wetland lies adjacent to Hamlin Lake. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Hamlin Lake Wetland #3.

Climate

The closest weather station providing climatic data for Hamlin Lake Wetland #3 is located in Ludington, Michigan. In 1975, the average monthly

temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Hamlin Lake Wetland #3 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 088

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Hamlin Lake Wetland #3.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Hamlin Lake Wetland #3.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Hamlin Lake Wetland #3.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetland #3. The literature search yielded no site-specific information pertaining to major species, seasonal

distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetland #3. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Hamlin Lake Wetland #3.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Hamlin Lake Wetland #3 by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 088

Population

Hamlin Lake Wetland #3 is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-15 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-15. Population Data for the Vicinity of Hamlin Lake Wetland #3

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Hamlin Lake Wetland #3 is rural open space. The surrounding area is in agricultural and other rural open space uses. An access road is located a short distance to the east of Hamlin Lake Wetland #3 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1973; West Michigan Regional Planning Commission, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and its location suggests that it is subject to moderate population pressures.

Recreation

There are no known state or federal recreational facilities in Hamlin Lake Wetland #3.

Mineral, Energy, and Forest Resources

Hamlin Lake Wetland #3 lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of Hamlin Lake Wetland #3 is considered to be favorable for oil and gas field discoveries, there are presently no operations of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agriculture Stabilization and Conservation Service aerial photograph, 1973).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Hamlin Lake Wetland #3 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Hamlin Lake Wetland #3 (Michigan Water Quality Division, 1978). No site-specific information was

located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Hamlin Lake Wetland #3, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 088

The literature search identified no on-going or impending research projects pertaining to Hamlin Lake Wetland #3.

HAMLIN LAKE WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 089-090

Setting

The Hamlin Lake Wetland Complex, comprised of Hamlin Lake Wetlands #4 and #5, is located near the eastern shoreline of Lake Michigan in Mason County, Michigan. Each of the wetlands in this complex is situated more than 1,000 feet from the Lake Michigan shoreline, but they are included in this study because they are contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. Hamlin Lake Wetland #4 lies 2.5 miles north of the community of Hamlin Lake and two miles from the Lake Michigan shoreline. It is a Lacustrine System and occupies a low, non-wooded site. Hamlin Lake Wetland #5, also a Lacustrine System, occupies a low, wooded site. This wetland lies two miles north of the community of Hamlin Lake and 2.4 miles from the Lake Michigan shoreline (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

Hamlin Lake Wetland #4 has a total relief of 20 feet, with elevations ranging from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The total relief of Hamlin Lake Wetland #5 is 40 feet, with elevations ranging from 580 to 620 feet above sea level. The wetlands lie on a low lacustrine plain; the surrounding topography is flat to rolling.

Surficial Geology

The surficial geology of Hamlin Lake Wetlands #4 and #5 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Hamlin Lake Wetland #4 and #5 is Houghton muck. The surface layer of Houghton muck is comprised of brown to black, fibrous, loose granular matter. This well decomposed organic material includes some roots and is underlain with fibrous material, such as sedges and grasses, that is also well decomposed. Houghton muck is generally found in old lake beds (Wonser et al., 1939).

Hydrology

There are no streams flowing through Hamlin Lake Wetlands #4 and #5, but the wetlands are adjacent to Hamlin Lake (U.S.G.S. quadrangle map, Manistee,

Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in these wetlands.

Climate

The closest weather station providing climatic data for the Hamlin Lake Wetland Complex is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Hamlin Lake Wetland Complex (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 089-090

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Hamlin Lake Wetlands #4 and #5.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Hamlin Lake Wetlands #4 and #5.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity,

food sources, or relationship to water levels of the invertebrates present in Hamlin Lake Wetlands #4 and #5.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetlands #4 and #5. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Hamlin Lake Wetlands #4 and #5. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these wetlands.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting the two wetlands comprising the Hamlin Lake Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Hamlin Lake Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

Population

Hamlin Lake Wetlands #4 and #5 are located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-16 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-16. Population Data for the Vicinity of Hamlin Lake Wetlands #4 and #5

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Hamlin Lake Wetlands #4 and #5 is rural open space. The surrounding area is primarily in rural open space, with some agricultural open space. An access road crosses Hamlin Lake Wetland #4 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Planning Commission, 1975). The wetlands are under private ownership (Rockford Map Publishers, Inc., 1975), but the general absence of development may indicate that the wetlands face low to moderate development pressures.

Recreation

There are no known state or federal recreational facilities in Hamlin Lake Wetlands #4 and #5.

Mineral, Energy, and Forest Resources

Hamlin Lake Wetlands #4 and #5 are within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of the wetlands is favorable for oil and gas field discoveries,

there are presently no operations of this nature near the wetlands (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetlands (Smith, 1915).

Hamlin Lake Wetland #5 is wooded (Agriculture Stabilization and Conservation Service aerial photograph, 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest. There are no significant forest resources in Hamlin Lake Wetland #4.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Hamlin Lake Wetland #4 and #5 (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Hamlin Lake Wetland #4 and #5 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Hamlin Lake Wetland #4 and #5, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 089-090

The literature search identified no on-going or impending research projects pertaining to Hamlin Lake Wetlands #4 and #5.

NORTH BAYOU WETLAND

PHYSIOGRAPHIC SETTING

LM 091

Setting

North Bayou Wetland is located near the eastern shoreline of Lake Michigan in Mason County, Michigan, 1.3 miles north of the community of Hamlin Lake. Although it lies 3.1 miles from the Lake Michigan shoreline, North Bayou Wetland is included in this study because it is contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. The wetland is located at the eastern end of an inlet of Hamlin Lake and extends inland for approximately 1.5 miles. North Bayou Wetland is both a Palustrine and Lacustrine System and occupies a low, wooded site (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

The total relief of North Bayou Wetland is 60 feet; wetland elevations range from 580 to 640 feet above sea level, 0 to 60 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to rolling.

Surficial Geology

The surficial geology of North Bayou Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are two soil types found in North Bayou Wetland. Rifle peat is present in the northern part of the wetland, and Lupton muck is found in the southern part and along the Hamlin Lake shore. The surface layer of Rifle peat consists of brown or dark-brown organic matter, including partly-decomposed and well-decomposed wood and leaf material. Below this layer is brown, partially-decomposed fibrous material derived mainly from aquatic plants. Lupton muck has a surface layer of dark brown to black granular organic matter containing roots, and is underlain by dark brown, well-decomposed organic matter, tree trunks, and roots. This soil is poorly drained and has moderate natural fertility (Wonser et al., 1939).

Hydrology

There are no streams flowing through North Bayou Wetland, but the wetland is adjacent to North Bayou of Hamlin Lake (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in North Bayou Wetland.

Climate

The closest weather station providing climatic data for North Bayou Wetland is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of North Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 091

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of North Bayou Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in North Bayou Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in North Bayou Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to North Bayou Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to North Bayou Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting North Bayou Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in North Bayou Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 091

Population

North Bayou Wetland is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-17 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-17. Population Data for the Vicinity of North Bayou Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within North Bayou Wetland is agricultural and other rural open space. The surrounding area is primarily agricultural open space, but occasional residences are found throughout the area. A series of access roads have been constructed to the south of North Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Planning Commission, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and is probably subject to moderate development.

Recreation

There are no known state or federal recreational facilities in North Bayou Wetland.

Mineral, Energy, and Forest Resources

North Bayou Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the vicinity of North Bayou Wetland is favorable for oil and gas field discoveries, there are presently no operations of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915).

North Bayou Wetland is wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of North Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to North Bayou Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of North Bayou Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 091

The literature search identified no on-going or impending research projects pertaining to North Bayou Wetland.

MIDDLE BAYOU WETLAND

PHYSIOGRAPHIC SETTING

LM 092

Setting

Middle Bayou Wetland is located near the eastern shoreline of Lake Michigan in Mason County, Michigan, 0.4 mile east of the community of Hamlin Lake. Although it is 2.5 miles from the Lake Michigan shoreline, Middle Bayou Wetland is included in this study because it is contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. The wetland lies at the eastern end of Middle Bayou, an inlet of Hamlin Lake, and extends inland a distance of approximately one mile. Middle Bayou Wetland is both a Lacustrine and Palustrine System and occupies a low, wooded site (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

The total relief of Middle Bayou Wetland is 60 feet; wetland elevations range from 580 to 640 feet above sea level, 0 to 60 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to rolling.

Surficial Geology

The surficial geology of Middle Bayou Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type for Middle Bayou Wetland is Rifle peat. The surface layer of Rifle peat consists of brown or dark-brown organic matter, including partly-decomposed and well-decomposed wood and leaf material. This layer is underlain with brown, partially-decomposed fibrous material derived mainly from aquatic plants (Wonser et al., 1939).

Hydrology

No streams flow through Middle Bayou Wetland, but the wetland is adjacent to Middle Bayou of Hamlin Lake (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Middle Bayou Wetland.

Climate

The closest weather station providing climatic data for Middle Bayou Wetland is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Middle Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 092

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Middle Bayou Wetland.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent. Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetland adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Middle Bayou Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Middle Bayou Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Middle Bayou Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Middle Bayou Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Middle Bayou Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Middle Bayou Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

Population

Middle Bayou Wetland is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-18 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-18. Population Data for the Vicinity of Middle Bayou Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Middle Bayou Wetland and most of the surrounding area is rural open space. Access roads are located near Middle Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972). However, areas of concentrated residential development extend along both sides of Middle Bayou to the east of the wetland (West Michigan Regional Planning Commission, 1975). The wetland is under private ownership (Rockford Map Publishers, Inc., 1975), and development pressures are likely to be moderate.

Recreation

There are no known state or federal recreational facilities in Middle Bayou Wetland.

Mineral, Energy, and Forest Resources

Middle Bayou Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the vicinity of Middle Bayou Wetland is favorable for oil and gas field discoveries, there are presently no operations of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Middle Bayou Wetland is wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Middle Bayou Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Middle Bayou Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Middle Bayou Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 092

The literature search identified no on-going or impending research projects pertaining to Middle Bayou Wetland.

SOUTH BAYOU AREA WETLAND

LM 093

South Bayou Area Wetland appears on the U.S.G.S. quadrangle map for Manistee, Michigan (1958), which records its location at the southern end of Hamlin Lake, near the eastern shoreline of Lake Michigan in Mason County, Michigan. However, recent aerial photographs (Agricultural Stabilization and Conservation Service, 1973) show that the wetland has been completely drained, so South Bayou Area Wetland will receive no further consideration in this study.

PINEY RIDGE AREA WETLAND

PHYSIOGRAPHIC SETTING

LM 094

Setting

Piney Ridge Area Wetland is located near the eastern shoreline of Lake Michigan in Mason County, Michigan, 0.6 mile west of the community of Hamlin Lake. Although it is 1.1 miles from the Lake Michigan shoreline, Piney Ridge Area Wetland is included in this study because it is contiguous with Hamlin Lake, which is influenced by the water levels of Lake Michigan. Sand dunes over 100 feet high are situated near the wetland, which is a Lacustrine System and occupies a low, partially wooded site near Ludington State Park (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

The total relief of Piney Ridge Area Wetland is 20 feet; wetland elevations range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to rolling.

Surficial Geology

The surficial geology of Piney Ridge Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Hamlin Lake (Martin, 1957; Dorr and Eschman, 1976).

Soils

The soil type in Piney Ridge Area Wetland is Bridgman fine sand, which has a surface lay of dark brown organic matter underlain by light gray or white, strongly acid, fine sand. Bridgman fine sand is generally found on forested sand dunes along Lake Michigan and Hamlin Lake (Wonser et al., 1939).

Hydrology

No streams flow through Piney Ridge Area Wetland, but the wetland is adjacent to Hamlin Lake (U.S.G.S. quadrangle map, Manistee, Michigan, 1958). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Piney Ridge Area Wetland.

Climate

The closest weather station providing climatic data for Piney Ridge Area Wetland is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0 F, the average daily low for January was 20.1 F and the

average daily high in July was 80.7^oF. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28^oF) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Piney Ridge Area Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 094

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Piney Ridge Area Wetland.

Fish

A list of species found in Hamlin Lake is presented in Appendix A-1. Most of these species, except the salmonids, probably utilize the wetlands along Hamlin Lake to some extent (Brown and Kilpela (1942) found an abundance of vertebrate and invertebrate fish food sources in Hamlin Lake, although food habit studies were not reported. This forage abundance and the availability of cover (including coastal wetlands) made the lake extremely productive of fish, and a popular sport fishery was noted. More current, but unpublished, records of the fish fauna of the wetlands adjacent to this important recreational lake probably exist in the files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Piney Ridge Area Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Piney Ridge Area Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Piney River Area Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use,

life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

According to Scharf et al. (1977), the Ludington State Park area is important for hawk, passerine, and shorebird migrations. Large numbers of hawks and warblers pass through the vicinity, particularly in the spring. Hamlin Lake is also known for waterfowl concentration during fall migration (Jaworski and Raphael, 1978).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Piney Ridge Area Wetland.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Piney Ridge Area Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Piney Ridge Area Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 094

Population

Piney Ridge Area Wetland is located in Hamlin Township of Mason County, Michigan. The county is sparsely populated, having a density of 46 persons per square mile. Table 4-19 indicates that Mason County experienced a rapid rate of population growth between 1970 and 1975, but the population of Hamlin Township remained stable during the same time period. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-19. Population Data for the Vicinity of Piney Ridge Area Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Hamlin Township	1,927	0.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Piney Ridge Area Wetland and most of the surrounding area is rural open space (Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Planning Commission, 1975). The wetland is under private ownership and lies within the Piney Ridge Resort area (Rockford Map Publishers, Inc., 1975). The immediate presence of residential and recreational land use surrounding the wetland, coupled with private ownership, probably reflects moderate development pressures.

Recreation

Piney Ridge Area Wetland lies adjacent to the 4,156-acre Ludington State Park. The park is primarily known for its outstanding system of foot trails and its sandy beaches. Other activities available in the park include boating, fishing, hunting, and picnicking (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Piney Ridge Area Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). The wetland is situated near coastal sand dune areas. Dune and coastal strip sands are the leading sources of industrial quality sand, owing to their purity and superior physical qualities. At present, however, there are no sand extraction operations in or near Piney Ridge Area Wetland (Michigan Geological Survey, 1975). Gravel resources are also found in the vicinity of the wetland, but no active gravel operations are present (Agricultural Stabilization and Conservation Service, aerial photograph, 1976).

Although the vicinity of Piney Ridge Area Wetland is favorable for oil and gas field discoveries, there are presently no operations of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Piney Ridge Area Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Piney Ridge Area Wetland (U.S.G.S. quadrangle map, Manistee, Michigan, 1958).

Pollution Sources

There are no NPDES permit holders adjacent to Piney Ridge Area Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Piney Ridge Area Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 094

The literature search identified no on-going or impending research projects pertaining to Piney Ridge Area Wetland.

PERE MARQUETTE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 095

Setting

Pere Marquette River Wetland is located 0.5 mile from the eastern shoreline of Lake Michigan in Mason County, Michigan, 0.3 mile south of the city of Ludington. The wetland is included in this study because it is contiguous with Pere Marquette Lake, which is influenced by the water levels of Lake Michigan. It extends inland from Pere Marquette Lake for approximately 17 miles, following the flood plain of the Pere Marquette River, and is wooded except in the westernmost portion. Pere Marquette River Wetland is a lower perennial Riverine System and occupies a low site (U.S.G.S. quadrangle maps, Ludington, Michigan, 1959, and Custer, Michigan 1959; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Topography

The total relief of Pere Marquette River Wetland is 60 feet; wetland elevations range from 580 to 640 feet above sea level, 0 to 60 feet above the approximate mean elevation of Lake Michigan. The wetland occupies the low flood plain of the Pere Marquette River. Steep bluffs, located on either side of the river, mark the northern and southern boundaries of the flood plain. Upland topography is rolling to hilly; an area of high sand dunes is located to the south. The shoreline near Pere Marquette River Wetland is described by the Great Lakes Basin Commission (1975) as low sand dunes.

Surficial Geology

Pere Marquette River Wetland is characterized by three types of surficial geology. The western part of the wetland near Ludington consists of lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion. The central portion of the wetland, between the communities of Scottville and Custer, is characterized by ground moraines. Ground moraine formations, deposited by retreating ice, have little relief and are usually found on plains; these deposits consist of a thin drift cover of till. The portion of the wetland east of Custer is an area of outwash and glacial channels. Outwash formations consist of sorted and stratified material laid down by streams of glacial meltwater, and consist of sand and gravel (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are three soil types present in Pere Marquette River Wetland: Kerston muck in the western part, Griffin sandy loam from Scottville east, and Lupton muck in a small, south-central portion of the wetland (Wonser et al., 1939).

Kerston muck is a very poorly drained alluvial soil which ranges from almost entirely organic soil to muck or peat with mineral soil mixed in. Griffin sandy loam is a mineral soil deposited by streams. The surface layer consists of dark gray, sandy loam that is usually high in organic matter, underlain by grayish-brown, sandy loam in addition to layers of sand, silt, and clay. In some places, recent alluvial deposits (layers of yellow or yellowish-brown fine sand) are included in Griffin sandy loam. Lupton muck has a surface layer of dark brown to black granular organic matter containing roots, underlain by dark brown, well decomposed organic matter, tree trunks, and roots. Lupton muck is poorly drained and has moderate natural fertility (Wonser et al., 1939).

Hydrology

Pere Marquette River Wetland is located in the flood plain of the Pere Marquette River, which flows west through the wetland. Swanson Creek, Lichte Creek, Swan Creek, India Creek, Big South Branch of Pere Carr Creek, Black Creek, Weldon Creek, and at least five unnamed perennial streams and numerous intermittent streams flow through the wetland as tributaries to the Pere Marquette River. The western end of Pere Marquette River Wetland is adjacent to Pere Marquette Lake (U.S.G.S. quadrangle maps, Ludington, Michigan, 1959; Custer, Michigan, 1959).

The Pere Marquette River has a drainage area of 709 square miles and a mean discharge of 850 cubic feet per second. The temperature of the river ranges from a maximum of 24.5°C to a minimum of 0°C (U.S. Geological Survey, Water Resources Division, 1977). The water quality of the Pere Marquette River is generally good, although Pere Marquette Lake has elevated levels of coliform bacteria and toxic substances (Great Lake Basin Commission, 1975). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in Pere Marquette River Wetland.

Climate

The closest weather station providing climatic data for Pere Marquette River Wetland is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Pere Marquette River Wetland (U.S.G.S. quadrangle maps, Ludington, Michigan, 1959, and Custer, Michigan, 1959; Michigan State Department of Highways and Transportation aerial photograph, 1973).

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Pere Marquette River Wetland.

Fish

Table 4-20 indicates fish species found in the vicinity of Ludington, many of which probably occur in Pere Marquette Lake and Pere Marquette River. None of the threatened or endangered species listed from the vicinity are commonly associated with wetlands. The Ludington Harbor, and probably Pere Marquette Lake, are popular sport fishing areas (U.S. Army Corps of Engineers, 1975).

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Pere Marquette River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pere Marquette River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

A section of Pere Marquette River Wetland was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance, which identified high-quality waterfowl areas that were inadequately protected from private development (Martz, 1976). Since it is one of the largest wetland areas on the Lower Peninsula shoreline of Lake Michigan, Pere Marquette River Wetland is very important for local waterfowl production and migration. According to Jaworski and Raphael (1978), Pere Marquette Lake is an important waterfowl concentration area during fall migration.

Estimated waterfowl production and migrational data for Pere Marquette River Wetland appear in Table 4-21. Dabbling ducks, including mallards (Anas platyrhynchos), wood ducks (Aix sponsa), black ducks (Anas rubripes), green-winged teals (A. crecca), and blue-winged teals (A. discors) are the primary users of the area. Of all waterfowl present, the average density of breeders is 24 pair per square mile. Average production is 0.33 young per wetland acre. Peak fall populations reach approximately 1,200 ducks and geese.

Table 4-20. Fish Species Found in the Vicinity of Ludington,
Mason County, Michigan^a

Family and common name	status ^b	Family and common name	status ^b
Acipenseridae		Cyprinidae	
lake sturgeon	TE	carp	C
		spottail shiner	C
Salmonidae		emerald shiner	C
lake whitefish	C		
lake herring	TE	Catostomidae	
longjaw cisco	TE	longnose sucker	C
shortjaw cisco	TE	white sucker	C
kiyi	TE		
bloater	TE	Gadidae	
round whitefish	C	burbot	C
lake trout	C		
brown trout	C	Percopsidae	
rainbow trout	C	trout-perch	C
coho salmon	C		
chinook salmon	C	Centrarchidae	
Atlantic salmon	C	smallmouth bass	C
Osmeridae		Percidae	
rainbow smelt	C	walleye	C
		yellow perch	C
Esocidae		logperch	C
northern pike	C		
		Cottidae	
Clupeidae		mottled sculpin	C
alewife	C	slimy sculpin	C
Gasterosteidae			
ninespine stickleback	C		

^afrom U.S. Army Corps of Engineers (1975)

^bTE=threatened or endangered

C=common

Table 4-21. Estimated Waterfowl Production and Migrational Use of Pere Marquette River Wetland

Species	Production		Migration		Avg duration (no. weeks)
	Avg density (prs/sq mi)	Avg young/ wetland acre	Avg peak population	Avg fall population	
DUCKS					
mallard	12	0.16	1,000	600	7
black duck	3	0.05	300	100	8
green-winged teal	1	0.01	100	60	6
blue-winged teal	2	0.03	200	80	5
wood duck	6	0.08	500	300	5
Total Ducks	24	0.33	2,100	1,140	
GEESE					
Canada goose	0	0	500	50	
Total Geese	0	0	500	50	
Total Anatidae	24	0.33	2,600	1,190	

^aMartz, 1976

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pere Marquette River Wetland. The literature search provided no site-specific information pertaining to recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Pere Marquette River Wetland is considered exceptional habitat for muskrat (*Ondatra zibethicus*) (Jaworski and Raphael, 1978). However, the literature search provided no site-specific data pertaining to other major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Pere Marquette River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Pere Marquette River Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Pere Marquette River Wetland is good for production of waterfowl. However, six NPDES permit holders and several sand and gravel operations are located near the wetland and may have some effect on its health.

CULTURAL SETTING

LM 095

Population

Pere Marquette River Wetland is located in the townships of Pere Marquette, Amber, Custer, and Branch in Mason County, Michigan. Portions of the wetland are adjacent to the communities of Ludington and Scottville. Mason County is sparsely populated, having a density of 46 persons per square mile. Table 4-22 indicates that Mason County experienced a rapid rate of growth between 1970 and 1975. During the same time period, Amber Township experienced a slow decline in population, while the town of Scottville, the city of Ludington, Branch Township, and Custer Township underwent rapid growth and Pere Marquette Township grew at a moderate rate. Projections for 1990 indicate that Mason County is expected to undergo continued rapid population growth.

Table 4-22. Population Data for the Vicinity of Pere Marquette River Wetland

	Estimated Population 1975 ^a	Estimated 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Amber Township	1,263	-1.2	--
Pere Marquette Township	1,927	4.4	--
Custer Township	345	7.8	--
Branch Township	793	24.9	--
City of Ludington	9,545	5.8	--
Town of Scottville	1,387	15.4	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Pere Marquette River Wetland is rural open space. The surrounding area is primarily agricultural open space, with areas of industrial, commercial, and residential development (the communities of Ludington, Scottville, and Custer) north of the wetland. Several highways cross Pere Marquette River Wetland, and access roads lie adjacent to the wetland at various locations. Sand pits and salt wells are common nearby. Settling ponds have been constructed in the wetland south of the community of Scottville (U.S.G.S. quadrangle maps, Ludington, Michigan, 1959; Custer, Michigan, 1959; Michigan Department of State Highways and Transportation aerial photograph, 1973; West Michigan Regional Planning Commission, 1975). Pere Marquette River Wetland is primarily under private ownership; parcels under federal, state, and local ownership are scattered through the wetland (Rockford Map Publishers, Inc., 1975).

Pere Marquette River Wetland is considered to be an "Area of Particular Concern" under Michigan's Coastal Zone Management Program owing to the threat of development by industrial and residential users (West Michigan Regional Planning Commission, 1977). At present, this wetland faces severe development pressures. A large part of the wetland at the east end of Pere Marquette Lake has been filled with industrial chemical wastes and fill from the city of Ludington. Most of the filling has occurred in the area to the west of U.S. Highway 31, but the dikes holding the fill may breach and erode, threatening portions of the remaining wetland areas (Michigan Department of Natural Resources, personal communication). According to Martz (1976), development pressures on the wetland in the next few years will be from oil and gas extraction, residential encroachment, and highway expansion.

Recreation

There are no known state or federal recreational facilities in the vicinity of Pere Marquette River Wetland.

Mineral, Energy, and Forest Resources

Pere Marquette River Wetland lies within an area of Silurian salt deposits underlain by Devonian salt deposits, and several salt wells are located in the southwest corner of the wetland near the Pleasantview School (Gere, 1977). Portions of the wetland are situated among coastal sand dune areas; several large sand and gravel operations are located along the wetland perimeter. One pit operation is located just off the wetland boundary immediately east of the Lichte Creek drainage basin. Two other large sand and gravel pits are located along the northern edge of the wetland near the communities of Scottville and Custer (Michigan Geological Survey, 1975).

Although Pere Marquette River Wetland is situated in an area favorable for oil and gas field discoveries, there are no drilling operations in the immediate vicinity. However, the Riverton Oil Field lies about four miles south of the wetland (Great Lakes Basin Commission, 1974; Michigan Geological Survey, 1977). There are no coal deposits present near the wetland (Smith, 1915).

Most of Pere Marquette Wetland is wooded (Michigan State Department of Highways and Transportation aerial photograph, 1973), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

Transmission lines from the Ludington pumped storage hydroelectric generating plant run through and to the south of Pere Marquette River Wetland. The Ludington plant, located about 1.4 miles south of the wetland, is owned by the Consumers Power Company and the Detroit Edison Company and is rated at 1980 megawatts. The plant's upper reservoir has a capacity of approximately 27 billion gallons and a surface area of about 1.3 square miles (Great Lakes Basin Commission, 1975; Federal Energy Administration, 1977).

The Scottville Wastewater Plant and the Custer Wastewater Plant are also located in the vicinity of Pere Marquette River Wetland.

Pollution Sources

There are six NPDES permit holders in the vicinity of Pere Marquette River Wetland. The Dow Chemical Company discharges process waste from a lagoon into Pere Marquette Lake. The Scottville Wastewater Plant discharges into the Pere Marquette River, and the Custer Wastewater Plant discharges into Black Creek, which flows into the Pere Marquette River. The type of discharge from these plants is not known. The Harbison Walker Refractories Company, a Division of Dressor Industries, discharges an unknown material into the Pere Marquette River near the western part of the wetland. Stokley Van Camp, Incorporated, discharges process wastes via spray irrigation north of the wetland near

Scottville. This company also discharges process water and cooling water from two outfalls into Foster Creek, a tributary to the Pere Marquette River near Scottville. The effect (if any) of these NPDES permit holders on Pere Marquette River Wetland is not known (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Pere Marquette River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 095

The literature search identified no on-going or impending research projects pertaining to Pere Marquette River Wetland.

BASS LAKE WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 096-098

Setting

The Bass Lake Wetland Complex, comprised of Kibby Creek Area Wetland and Bass Lake Wetlands #1 and #2, is situated near the eastern shoreline of Lake Michigan in Mason and Oceana Counties, Michigan. Kibby Creek Area Wetland is 4.1 miles north of the community of Pentwater and 0.6 mile from the Lake Michigan shoreline. Bass Lake Wetland #1 is 3.2 miles north of Pentwater and 0.1 mile from Lake Michigan, while Bass Lake Wetland #2 lies 1.5 miles north of Pentwater and 0.8 mile from the Lake Michigan shoreline.

Kibby Creek Area Wetland is located on the north side of Bass Lake, adjacent to Kibby Creek. This wetland is a low, wooded, Lacustrine System. Bass Lake Wetland #1 is situated on the north side of the stream that connects Bass Lake and Lake Michigan. This wetland is a Riverine System and occupies a low, non-wooded site. Bass Lake Wetland #2 is located at the southern end of Bass Lake, and is a Riverine System which occupies a low, wooded site (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Topography

Kibby Creek Area Wetland and Bass Lake Wetland #2 each have a total relief of 6 feet, with elevations ranging from 582 to 588 feet above sea level, 2 to 8 feet above the approximate mean elevation of Lake Michigan. The total relief of Bass Lake Wetland #1 is 5 feet; wetland elevations range from 580 to 585 feet above sea level. The wetlands are situated on a lacustrine plain, and the surrounding topography is rolling to flat. The Lake Michigan shoreline near the wetlands of this complex is described by the Great Lakes Basin Commission (1975) as an area of high sand dunes.

Surficial Geology

The surficial geology of the Bass Lake Wetland Complex is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the shoreline of Bass Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

Three soil types are present in the Bass Lake Wetland Complex: Bridgman fine sand in Bass Lake Wetland #1, Greenwood peat in Kibby Creek Area Wetland, and Carlisle muck in Bass Lake Wetland #2 (Wonser et al., 1939).

Bridgman fine sand has a surface layer of dark brown organic matter underlain by light gray or white, strongly acid, fine sand. This soil is usually found on forested sand dunes along Lake Michigan. Carlisle muck

consists of entirely decayed and partly decayed organic matter. The surface layer of this soil is dark brown to black, granular, well decomposed organic matter underlain with less well decomposed material including woody material, sedges, grasses, and reeds. Carlisle muck is poorly drained and may have areas of standing water. The surface layer of Greenwood peat consists of yellowish-brown, coarse, fibrous raw peat which is mostly organic matter. This material is underlain by peat composed of sedges, reeds, and aquatic plant materials which form a spongelike mat. Greenwood peat is a poorly drained, strongly acidic soil (Wonser et al., 1939).

Hydrology

Bass Lake Wetland #1 is adjacent to the outlet of Bass Lake into Lake Michigan. An unnamed perennial stream flows north through the middle of Bass Lake Wetland #2 and into Bass Lake. Kibby Creek Area Wetland has an area of open water located in the west-central part of the wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959).

The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in the three wetlands of this complex.

Climate

The closest weather station providing climatic data for the Bass Lake Wetland Complex is located in Ludington, Michigan. In 1975, the average monthly temperature was 47.0°F, the average daily low for January was 20.1°F and the average daily high in July was 80.7°F. The average annual precipitation is 31.36 inches, with a mean monthly precipitation of 2.42 inches in January and 2.46 inches in July based on the normal period from 1941-1970. The growing season is approximately six months long, with the last killing frost (28°F) in 1975 occurring on April 25 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Bass Lake Wetland Complex (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1972).

BIOTIC SETTING

LM 096-098

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of the Bass Lake Wetland Complex.

Fish

In 1932, species found in Bass Lake included northern pike (Esox lucius), bowfin (Amia calva), longnose gar (Lepisosteus osseus), bluntnose minnow (Pimephales notatus), goldenshiner (Notemigonus crysoleucas), brown bullhead (Ictalurus nebulosus), yellow bullhead (Ictalurus natalis), largemouth bass (Micropterus salmoides), black crappie (Pomoxis nigromaculatus), white crappie (Pomoxis annularis), rock bass (Ambloplites rupestris), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), and yellow perch (Perca flavescens). Aquatic vegetation along the lake was believed to provide needed cover and feeding areas for these species, and Bass Lake Wetland #2 was believed to be suitable for northern pike spawning. Recreational fishing was pursued in Bass Lake. All the above species were common, and the lake was deemed relatively good for fish production (Hubbs and Eschmeyer, 1932). Except for the note on possible northern pike spawning in Bass Lake Wetland #2, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Bass Lake Wetland Complex.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in the Bass Lake Wetland Complex.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Bass Lake Wetland Complex. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in these wetlands.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Bass Lake Wetland Complex. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these wetlands.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship

to water levels of the mammals inhabiting the three wetlands comprising the Bass Lake Wetland Complex.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Bass Lake Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands. However, an NPDES permit holder is located near these wetlands and may have some effect on its health.

CULTURAL SETTING

LM 096-098

Population

Kibby Creek Area Wetland and Bass Lake Wetland #1 are located in Summit Township of Mason County, Michigan. Bass Lake Wetland #2 is located in Pentwater Township of Oceana County. Table 4-23 indicates that Mason County, Oceana County, Summit Township, and Pentwater Township all experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that both counties are expected to undergo continued rapid population growth.

Table 4-23. Population Data for the Vicinity of the Bass Lake Wetland Complex

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Mason County	24,517	8.4	30,667
Summit Township	616	10.6	--
Oceana County	20,663	14.9	28,305
Pentwater Township	1,353	18.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within the wetlands of the Bass Lake Wetland Complex is rural open space. The area surrounding the wetlands is characterized primarily by rural open space near the Lake Michigan shore, and agricultural open space further

inland. Residences are located along most of the Bass Lake shoreline. An access road is adjacent to Kibby Creek Area Wetland and secondary highways lie adjacent to Bass Lake Wetlands #1 and #2 (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1972; West Michigan Regional Commission, 1975). The wetlands are under private ownership; portions of all three wetlands lie within an area of subdivisions and small tracts (Rockford Map Publishers, Inc., 1975).

Bass Lake has been designated as an "Area of Particular Concern" under Michigan's Coastal Zone Management Program because of concern that increasing development around the lake without proper public sewage facilities will lower water quality (West Michigan Regional Planning Commission, 1977). Bass Lake Wetland #2, extending primarily into Oceana County, is within an area classified as having much greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977).

The presence of small tract ownership, combined with fairly extensive residential development in the immediate vicinity of the wetland, suggests that Kibby Creek Area Wetland and Bass Lake Wetlands #1 and #2 may be subject to high development pressures. The future of these wetlands depends largely upon the outcome of the Coastal Zone Management Program; without the protection of this program, it is highly probable that residential development will occur.

Recreation

There are no known state or federal recreational facilities in the vicinity of Bass Lake Wetlands #1 and #2 and Kibby Creek Area Wetland.

Mineral, Energy, and Forest Resources

Bass Lake Wetlands #1 and #2 and Kibby Creek Area Wetland lie within an area of Silurian salt deposits. However, there are no operations in or near the wetlands utilizing these resources (Gere, 1977). The wetlands are situated near coastal sand dune areas. Dune and coastal strip sands are the leading sources of industrial quality sand, owing to their purity and superior physical qualities, but at present there are no sand extraction operations in or near Bass Lake Wetlands #1 and #2 or Kibby Creek Area Wetland (Michigan Geological Survey, 1975). Gravel Resources are also found in the vicinity of the wetlands, but no active gravel operations are present (Agricultural Stabilization and Conservation Service aerial photograph, 1972).

Although in the vicinity of Bass Lake Wetlands #1 and #2 and Kibby Creek Area Wetland is favorable for oil and gas field discoveries, there are presently no drilling operations near the wetlands (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetlands (Smith, 1915).

Kibby Creek Area Wetland and Bass Lake Wetland #2 are wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1972). It was not determined through the literature search whether these wooded areas are subject to commercial timber harvest. There are no significant forest resources present in Bass Lake Wetland #1.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Bass Lake Wetlands #1 and #2 and Kibby Creek Area Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959).

Pollution Sources

There is one NPDES permit holder located in the vicinity of the Bass Lake Wetland Complex. The Ludington Fruit Exchange Company of Ludington is located on the eastern edge of Bass Lake. Process waters from spray irrigation drain via a lagoon into Bass Lake by way of Durham Creek. The extent and effect (if any) of this discharge on the wetlands is not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Bass Lake Wetlands #1 and #2 or Kibby Creek Area Wetland. However, the Michigan Coastal Zone Inventory indicates that two archaeological sites (20-MN-33 and 20-MN-34) are present in the vicinity of Bass Lake Wetland #1. Three sites (20-MN-35, 20-MN-36, and 20-MN-37) are located near Bass Lake Wetland #2, and three more sites (20-MN-38, 20-MN-40, and 20-MN-41) are near Kibby Creek Wetland. All eight sites are habitations of an unknown culture and date (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 096-098

The literature search identified no on-going or impending research projects pertaining to the Bass Lake Wetland Complex.

PENTWATER LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 099

Setting

Pentwater Lake Wetland is located near the eastern shoreline of Lake Michigan in Oceana County, Michigan, 0.6 mile southeast of the community of Pentwater. Although it is 1.6 miles from the Lake Michigan shoreline, Pentwater Lake Wetland is included in this study because it is less than 1,000 feet from the shoreline of Pentwater Lake, which is influenced by the water levels of Lake Michigan. Pentwater Lake Wetland is a non-wooded Palustrine System (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Pentwater Lake Wetland is 20 feet; wetland elevations range from 640 to 660 feet above sea level, 60 to 80 feet above the approximate mean elevation of Lake Michigan. Pentwater Lake Wetland lies in an area of sand dunes above Pentwater Lake, on a low lacustrine plain; the surrounding topography is rolling to hilly.

Surficial Geology

The surficial geology of Pentwater Lake Wetland is characterized by sand dunes, which are found along the Lake Michigan shoreline from an area north of Pentwater to Little Sable Point (Martin, 1957).

Soils

The soil type for Pentwater Lake Wetland is Houghton muck. The surface layer of this soil is comprised of brown to black, fibrous, loose granular organic matter which includes some roots, underlain with fibrous material, such as sedges and grasses, that is also well decomposed. Houghton muck is generally found in old lake beds (Wonser et al., 1938).

Hydrology

There are no streams flowing through Pentwater Lake Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Pentwater Lake Wetland is located in Hart, Michigan. In 1975, the average monthly temperature was 47.8°F, the average daily low for January was 20.0°F and the average daily high in July was 81.7°F. The average annual precipitation is 32.74 inches, with

a mean monthly precipitation of 2.56 inches in January and 2.94 inches in July based on the normal period from 1941-1970. The growing season is approximately six and three-quarters months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 15 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Pentwater Lake Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 099

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Pentwater Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Pentwater Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Pentwater Lake Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pentwater Lake Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Data recorded in nearby Pentwater River Wetland (Martz, 1976; Michigan Department of Natural Resources, Pentwater State Game Area management Program, undated) may be applicable to Pentwater Lake Wetland. Of the waterfowl using the Pentwater River area, dabbling ducks, including mallards (Anas

platyrhynchos), black ducks (A. rubripes), wood ducks (Aix sponsa), and blue-winged teals (A. discors) are the most numerous. Canadian geese (Branta canadensis), scaup, and ring-necked ducks (Aythya collaris) are next in order of abundance. Mallards, black ducks, and blue-winged teal are local breeders. Upland areas support populations of ruffed grouse (Bonasa umbellus) and woodcock (Philohela minor).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pentwater Lake Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing Pentwater Lake Wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Pentwater Lake Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Pentwater Lake Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 099

Population

Pentwater Lake Wetland is located in Pentwater Township of Oceana County, Michigan. The county is sparsely populated, having a density of 34 persons per square mile. Table 4-24 indicates that Oceana County and Pentwater Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Oceana County is expected to undergo continued rapid population growth.

Table 4-24. Population Data for the Vicinity Pentwater Lake Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Oceana County	20,663	14.9	28,305
Pentwater Township	1,353	17.2	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Pentwater Lake Wetland is rural open space. The surrounding area is characterized primarily by agricultural and other rural open space uses, with an area of residential, commercial, and industrial development (the town of Pentwater) northwest of the wetland. A primary highway is located between Pentwater Lake Wetland and Pentwater Lake (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland lies within an area plotted for subdivisions and small tracts (Rockford Map Publishers, Inc., 1978). Although detailed ownership records of this area are unavailable, wetland ownership is assumed to be private. Since the wetland lies within an area estimated to have greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977), Pentwater Lake Wetland may be subject to moderate to high development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Pentwater Lake Wetland.

Mineral, Energy, and Forest Resources

Pentwater Lake Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Dune and coastal strip sands like those surrounding the wetland are the leading sources of industrial quality sand, owing to their purity and superior physical qualities, but at present there are no sand extraction operations in or near Pentwater Lake Wetland (Michigan Geological Survey, 1975). Gravel resources are also found in the vicinity of the wetland, but no active gravel operations are present (Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Although the vicinity of Pentwater Lake Wetland contains oil and gas pools, there are presently no drilling operations in close proximity to the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any

significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Pentwater Lake Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Pentwater Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Pentwater Lake Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 099

The literature search identified no on-going or impending research projects pertaining to Pentwater Lake Wetland.

PENTWATER RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 100

Setting

Pentwater River Wetland is located near the eastern shoreline of Lake Michigan in Oceana county, Michigan, 1.5 miles southeast of the community of Pentwater. Although the wetland is 1.8 miles from the Lake Michigan shoreline, it is included in this study because it is contiguous with Pentwater Lake, which is influenced by the water levels of Lake Michigan. Pentwater River Wetland is a lower perennial Riverine System and is non-wooded (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Pentwater River Wetland is 20 feet; wetland elevations range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland is located on a low lacustrine plain; upland topography is rolling to hilly.

Surficial Geology

The surficial geology of Pentwater River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along the western portion of the Pentwater River Basin (Martin, 1957; Dorr and Eschman, 1970).

Soils

There are two soil types found in Pentwater River Wetland, Houghton muck in the northern part of the wetland and Kerston muck in the southern part. Kerston muck is a very poorly drained alluvial soil which ranges from a nearly pure organic soil to muck or peat with mineral soil mixed in. The surface layer of Houghton muck is comprised of brown to black, fibrous, loose granular matter. This well decomposed organic material includes some roots and is underlain with fibrous material, such as sedges and grasses, that is also well decomposed. Houghton muck is generally found in old lake beds (Wonser et al., 1938).

Hydrology

The Pentwater River flows north through Pentwater River Wetland to Pentwater Lake. Watson Creek and Dumaw Creek, tributaries to the Pentwater River, enter the wetland at its northeastern border. The wetland is adjacent to Pentwater Lake (U.S.G.S. quadrangle maps, Ludington, Michigan, 1959; Hart, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Pentwater River Wetland is located in Hart, Michigan. In 1975, the average monthly temperature was 47.8°F, the average daily low for January was 20.0°F and the average daily high in July was 81.7°F. The average annual precipitation is 32.74 inches, with a mean monthly precipitation of 2.56 inches in January and 2.94 inches in July based on the normal period from 1941-1970. The growing season is approximately six and three-quarters months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 15 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Pentwater River Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 100

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Pentwater River Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Pentwater River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Pentwater River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pentwater River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Pentwater River Wetland was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance of inadequately protected high quality waterfowl areas (Martz, 1976). The western section of this wetland is also incorporated in the Pentwater State Game Area.

Waterfowl are the primary avian users of Pentwater River Wetland. Dabbling ducks, including mallards (Anas platyrhynchos), black ducks (A. rubripes), blue-winged teals (A. discors), and wood ducks (Aix sponsa), are most numerous. Canada geese (Branta canadensis), scaup, and ring-necked ducks (Aythya collaris) are next in order of abundance. Estimates of waterfowl production and migrational use in Pentwater River Wetland are presented in Table 4-25.

Waterfowl and upland game hunting are among the primary human uses of this area (Michigan Department of Natural Resources, Pentwater State Game Area Management Program, undated). Waterfowl utilization is greatest during periods of high water, when the floodplain is submerged. A number of potholes have been blasted in the state management area to increase waterfowl use during drier periods. There have also been some upland cuttings and shrub plantings to improve habitat for species such as ruffed grouse (Bonasa umbellus) and woodcock (Philohela minor).

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Pentwater River Wetland. The literature search provided no site-specific information pertaining to commercial use, health, life histories, or major food sources of the birds utilizing Pentwater River Wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Pentwater River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Pentwater River Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Pentwater River Wetland is good for the production of waterfowl.

Information is insufficient to evaluate this wetland as habitat for fish, mammals, or reptiles and amphibians.

Table 4-25. Estimated Waterfowl Production and Migrational Use of Pentwater River Wetland^a

Species	Production		Migration		
	Avg density (prs/sq mi)	Avg young/ wetland acre	Avg peak population	Avg fall population	Avg duration (no. weeks)
DUCKS					
mallards	10	2.0	3,000	200	6
black duck	2	0.1	100	50	6
blue-winged teal	2	0.1	100	50	4
Total Ducks	14	2.2	3,200	300	
Total Geese	0	0	200	0	
Total Anatidae	14	2.2	3,200	300	

^aMartz, 1976

Population

Pentwater River Wetland is located in Pentwater Township of Oceana County, Michigan. The county is sparsely populated, having a density of 34 persons per square mile. Table 4-26 indicates that Oceana County and Pentwater Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Oceana County is expected to undergo continued rapid population growth.

Table 4-26. Population Data for the Vicinity of Pentwater River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Oceana County	20,663	14.9	28,305
Pentwater Township	1,353	17.2	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Pentwater River Wetland is rural open space; the surrounding area is characterized primarily by agricultural and other rural open space uses. Primary and secondary highways are located adjacent to Pentwater River Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The northern portion of the wetland is under state ownership, but areas of private ownership exist in the southern portion of the wetland (Rockford Map Publishers, Inc., 1978).

Martz (1976) indicates that portions of Pentwater River Wetland are likely to be subject to development in the next five or more years. Martz believes that oil and gas development, residential development, and construction activities represent the major development pressures on the wetland.

Recreation

The wetland lies within the 520-acre Pentwater River State Game Area. The heaviest recreational use of the area is provided by summer campers; as many as 500 campers use the Pentwater River State Game Area on holiday weekends in the summer. Waterfowl hunting, and small game hunting and trapping, represent the

second most popular recreational uses of the game area. Snowmobiles, motorcycles, and other off-road vehicles are also permitted (Michigan Department of Natural Resources, Pentwater State Game Area Management Program, undated).

Mineral, Energy, and Forest Resources

Pentwater River Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of Pentwater River Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Pentwater River Wetland (U.S.G.S. quadrangle map, Ludington, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Pentwater River Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Pentwater River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Pebbles and Black, 1976).

RESEARCH PROJECTS

LM 100

The literature search identified no on-going or impending research projects pertaining to Pentwater River Wetland.

RICHMONDS INLET WETLAND

PHYSIOGRAPHIC SETTING

LM 101

Setting

Richmonds Inlet Wetland is located 250 feet from the eastern shoreline of Lake Michigan in Oceana County, Michigan, 6.5 miles west of the community of Hart. A small area of open water named Richards Inlet lies to the south of the wetland. Richmonds Inlet Wetland is an interdunal, Palustrine System and occupies a raised, partially wooded site (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Richmonds Inlet Wetland is 10 feet; wetland elevations range from 590 to 600 feet above sea level, 10 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland is situated among high coastal sand dunes; the surrounding topography is rolling to hilly.

Surficial Geology

The surficial geology of Richmonds Inlet Wetland is characterized by sand dunes, which are found along the Lake Michigan shoreline from an area north of Pentwater to Little Sable Point (Martin, 1957).

Soils

The soil type in Richmonds Inlet Wetland is Bridgman fine sand, which has a surface layer of dark brown organic matter underlain by light gray or white, strongly acid, fine sand. Bridgman fine sand is generally found on forested sand dunes along Lake Michigan (Wonser et al., 1938).

Hydrology

There are no streams flowing through Richmonds Inlet Wetland, but the wetland is adjacent to Richmonds Inlet (U.S.G.S. quadrangle map, Hart, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Richmonds Inlet Wetland is located in Hart, Michigan. In 1975, the average monthly temperature was 47.8°F, the average daily low for January was 20.0°F and the average daily high in July was 81.7°F. The average annual precipitation is 32.74 inches, with a mean monthly precipitation of 2.56 inches in January and 2.94 inches in July based on the normal period from 1941-1970. The growing season is approximately

six and three-quarters months long, with the last killing frost (28⁰F) in 1975 occurring on April 21 and the first killing frost on November 15 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Richmonds Inlet Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 101

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Richmonds Inlet Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Richmonds Inlet Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Richmonds Inlet Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Richmonds Inlet Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to the Richmonds Inlet Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Richmonds Inlet Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Richmonds Inlet Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 101

Population

Richmonds Inlet Wetland is located in Golden Township of Oceana County, Michigan. The county is sparsely populated, having a density of 34 persons per square mile. Table 4-27 indicates that Oceana County and Garden Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Oceana County is expected to undergo continued rapid population growth.

Table 4-27. Population Data for the Vicinity of Richmonds Inlet Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Oceana County	20,663	14.9	28,305
Golden Township	1,096	25.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Richmonds Inlet Wetland is rural open space. The surrounding area is primarily in agricultural and other rural open space uses, with an area of residential development inland from the wetland. Access roads

lie to the east and west of Richmonds Inlet Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland lies within the Juniper Beach subdivision (Rockford Map Publishers, Inc., 1978). Although detailed ownership records of this area are not available, wetland ownership is assumed to be private.

Since Richmonds Inlet Wetland lies within an area estimated to have much greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977), the wetland may be subject to moderate to high development pressures.

Recreation

Richmonds Inlet Wetland lies just north of the 2,685-acre Silver Lake State Park. Activities within the park include fishing, hiking, swimming, boating, and use of off-road vehicles (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Richmonds Inlet Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Dune and coastal strip sands like those surrounding the wetland are the leading sources of industrial quality sand due to their pureness and superior physical qualities, but at present there are no sand extraction operations in or near Richmonds Inlet Wetland (Michigan Geological Survey, 1975). Gravel resources are also found in the vicinity of the wetland, but no active gravel operations are present (Agricultural Stabilization and Conservation Service aerial photograph 1976).

Although the vicinity of Richmonds Inlet Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Richmonds Inlet Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1976). It was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Richmonds Inlet Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Richmonds Inlet Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Richmonds Inlet Wetland (Peebles and Black, 1976). However, the Michigan Coastal Zone Inventory indicates that three archaeological sites are present in the vicinity of the wetland. Sites 20-OA-41 and 20-OA-18 are mounds of unknown date and culture; site 20--17 is a cemetery, also of an unknown time period and culture (Peebles and Black, 1976). Further information regarding the field research and the location of these sites can be obtained from the Michigan History Division.

RESEARCH PROJECTS

LM 101

The literature search identified no on-going or impending research projects pertaining to Richmonds Inlet Wetland.

STONY CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 102

Setting

Stony Creek Wetland is located near the eastern shoreline of Lake Michigan in Oceana County, Michigan, 1.6 miles east of the community of Benona. Although the wetland is 1.9 miles from the Lake Michigan shoreline, it is included in this study because it is contiguous with Stony Lake. Higher elevations within Stony Creek Wetland are wooded; the area near Stony Lake is non-wooded. Stony Creek Wetland is a Lacustrine and lower perennial Riverine System which occupies a low site (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Stony Creek Wetland is 28 feet; wetland elevations range from 582 to 610 feet above sea level, 2 to 30 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain; the surrounding topography is rolling to hilly.

Surficial Geology

The surficial geology of Stony Creek Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found to the immediate south and east of Stony Lake (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Stony Creek Wetland is Kerston muck, a very poorly drained alluvial soil which ranges from a nearly pure organic soil to muck or peat with mineral soil mixed in (Wonser et al., 1938).

Hydrology

Stony Creek flows west through Stony Creek Wetland to Stony Lake. Two unnamed perennial streams, tributaries to Stony Creek, enter the wetland from the north, as do four short perennial streams in the southwestern part of the wetland. Burke Creek, Dorrance Creek, and an unnamed creek, also tributaries to Stony Creek, flow north into the eastern portion of the wetland. Stony Creek Wetland is adjacent to Stony Lake (U.S.G.S. quadrangle map, Hart, Michigan, 1959), and there are two areas of open water within the wetland. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Stony Creek Wetland is located in Hart, Michigan. In 1975, the average monthly temperature was 47.8°F, the average daily low for January was 20.0°F and the average daily high in July was 81.7°F. The average annual precipitation is 32.74 inches, with a mean monthly precipitation of 2.56 inches in January and 2.94 inches in July based on the normal period from 1941-1970. The growing season is approximately six and three-quarters months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 15 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Stony Creek Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 102

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Stony Creek Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Stony Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Stony Creek Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Stony Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contains general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Stony Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Stony Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Stony Creek Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 102

Population

Stony Creek Wetland is located in Benona Township of Oceana County, Michigan. The county is sparsely populated, having a density of 34 persons per square mile. Table 4-28 indicates that Oceana County and Benona Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Oceana County is expected to undergo continued rapid population growth.

Table 4-28. Population Data for the Vicinity of Stony Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Manistee County	21,766	6.7	25,500
Benona Township	1,096	25.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Stony Creek Wetland and most of the surrounding area is rural open space. An access road is located to the south of Stony Creek Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland is under private ownership (Rockford Map Publishers, Inc., 1978), and lies within an area estimated to have greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977). However, the wetland has been nominated as an "area of particular concern" under Michigan's Coastal Zone Management Program. Should the nomination be approved, the wetland will be preserved as a unique natural area (West Michigan Shoreline Regional Development Commission, 1977).

Recreation

There are no known state or federal recreational facilities in the vicinity of Stony Creek Wetland.

Mineral, Energy, and Forest Resources

Stony Creek Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the vicinity of Stony Creek Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Stony Creek Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1976), but it was not determined through the literature search whether this wooded area is used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Stony Creek Wetland (U.S.G.S. quadrangle map, Hart, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Stony Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Stony Creek Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 102

The literature search identified no on-going or impending research projects pertaining to Stony Creek Wetland.

CLAYBANKS TOWNSHIP WETLAND

PHYSIOGRAPHIC SETTING

LM 103

Setting

Claybanks Township wetland is located 0.2 miles from the eastern shoreline of Lake Michigan in Oceana County, Michigan, 6.5 miles northwest of the community of Montague. A bluffline, 60 feet high, lies between the wetland and the lakshore. Claybanks Township Wetland is a Palustrine System and occupies a raised, wooded site (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Claybanks Township Wetland is 10 feet; wetland elevations range from 650 to 660 feet above sea level, 70 to 80 feet above the approximate mean elevation of Lake Michigan. The wetland is located in a rolling morainal area. The shoreline near Claybanks Township Wetland is described by the Great Lakes Basin Commission (1975) as an erodible high bluff.

Surficial Geology

The surficial geology of Claybanks Township Wetland is characterized by moraines. Moraine formations are materials deposited by glacial action, and usually consist of till. Moraines are found along a small section of the Lake Michigan shoreline northwest of Montague (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type for Claybanks Township Wetland is Carlisle muck, which consists of entirely decayed and partly decayed organic matter. The surface layer of this soil is dark brown to black, granular, well decomposed organic matter, underlain with less well decomposed material including woody material, sedges, grasses, and reeds. Carlisle muck is poorly drained and may have areas of standing water (Wonser et al., 1938).

Hydrology

Claybanks Township Wetland is drained by a short perennial stream originating in the wetland. The eastern part of the wetland has an area of open water (U.S.G.S. quadrangle map, Montague, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Claybanks Township Wetland is located in Montague, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 19.8°F and the average daily high in July was 79.8°F. The average annual precipitation is 38.65 inches, with a mean monthly precipitation of 3.25 inches in January and 2.23 inches in July based on the normal period from 1941-1970. The growing season is approximately five months long, with the last killing frost (28°F) in 1975 occurring on May 16 and the first killing frost on October 11 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Claybanks Township Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 103

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Claybanks Township Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Claybanks Township Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Claybanks Township Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Claybanks Township Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contains general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Claybanks Township Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Claybanks Township Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Claybanks Township Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 103

Population

Claybanks Township Wetland is located in Claybanks Township of Oceana County, Michigan. The county is sparsely populated, having a density of 34 persons per square mile. Table 4-29 indicates that Oceana County and Claybanks Township both experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Oceana County is expected to undergo continued rapid population growth.

Table 4-29. Population Data for the Vicinity of Claybanks Township Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Oceana County	20,663	14.9	28,305
Claybanks Township	700	25.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Claybanks Township Wetland is rural open space. The surrounding area is characterized by agricultural and other rural open space uses. Access roads lie to the north and east of Claybanks Township Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland is under private ownership (Rockford Map Publishers, Inc., 1978), and lies within an area estimated to have greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977), so development pressures may be high.

Recreation

There are no known state or federal recreational facilities in the vicinity of Claybanks Township Wetland.

Mineral, Energy, and Forest Resources

Claybanks Township Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of Claybanks Township Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915).

Claybanks Township Wetland is wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1976), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Claybanks Township Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Claybanks Township Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Claybanks Township Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 103

The literature search identified no on-going or impending research projects pertaining to Claybanks Township Wetland.

FLOWER CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 104

Setting

Flower Creek Wetland is located 0.2 mile from the eastern shoreline of Lake Michigan in Oceana and Muskegon Counties, Michigan, 5.2 miles northwest of the community of Montague. The wetland is situated on either side of Flower Creek which flows into Lake Michigan. It is a lower perennial Riverine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Topography

The total relief of Flower Creek Wetland is 20 feet; wetland elevations range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a gently rolling morainal plain. The shoreline near Flower Creek Wetland is described by the Great Lakes Basin Commission (1975) as an erodible high bluff.

Surficial Geology

The surficial geology of Flower Creek Wetland is characterized by ground moraines. Ground moraine formations, deposited by retreating ice and consisting of a thin drift cover of till, have little relief and are usually found on plains. Ground moraines are found along a small section of the Lake Michigan shoreline northwest of Montague (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Flower Creek Wetland is Houghton peat and muck, which has a surface layer of granular black muck underlain with mucky peat and fibrous peat. This organic soil is very poorly drained and has low natural fertility. Houghton muck developed in fibrous marsh grasses, sedges, and reeds (Pregitzer, 1968).

Hydrology

Flower Creek meanders south through Flower Creek Wetland on its way to Lake Michigan (U.S.G.S. quadrangle map, Montague, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Flower Creek Wetland is located in Montague, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 19.8°F and the average daily high in July was 79.8°F. The average annual precipitation is 38.65 inches, with a mean monthly precipitation of 3.25 inches in January and 2.23 inches in July based on the normal period from 1941-1970. The growing season is approximately five months long, with the last killing frost (28°F) in 1975 occurring on May 16 and the first killing frost on October 11 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Flower Creek Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976).

BIOTIC SETTING

LM 104

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Flower Creek Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Flower Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Flower Creek Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Flower Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Flower Creek Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Flower Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in in Flower Creek Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 104

Population

Flower Creek Wetland is located in Whiteriver Township of Muskegon County and Claybanks Township of Oceana County, Michigan. Muskegon County has a moderate population density of 314 persons per square mile. Oceana County is sparsely populated, having a density of 34 persons per square mile. Table 4-30 indicates that the population of Muskegon County remained stable between 1970 and 1975. Whiteriver Township, Oceana County, and Claybanks Township experienced a rapid rate of growth during the same time period. Projections for 1990 indicate that the population of Muskegon County will remain stable, while Oceana county is expected to undergo continued rapid population growth.

Table 4-30. Population Data for the Vicinity of Flower Creek Wetland

	Estimated Population 1975 ^a	Estimated % Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	155,369
Whiteriver Township	1,199	18.0	--
Oceana County	20,663	14.9	28,305
Claybanks Township	700	25.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Flower Creek Wetland is rural open space. The surrounding area is characterized by agricultural and other rural open space uses. Access roads lie to the east, south, and west of Flower Creek Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland is under private ownership (West Michigan Shoreline Regional Development Commission, 1976; Rockford Map Publishers, Inc., 1978), and lies within the area estimated to have greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977), so development pressures may be high.

Recreation

There are no known state or federal recreational facilities in the vicinity of Flower Creek Wetland.

Mineral, Energy, and Forest Resources

Flower Creek Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the area in the vicinity of Flower Creek Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1976).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Flower Creek Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Flower Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Flower Creek Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 104

The literature search identified no on-going or impending research projects pertaining to Flower Creek Wetland.

WHITE RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 105

Setting

White River Wetland is located near the eastern shoreline of Lake Michigan in Oceana and Muskegon Counties, Michigan, adjacent to the community of Montague. The wetland occupies the flood plain of the White River and extends approximately 12 miles along the river. Although it lies 4.5 miles from the Lake Michigan shoreline, White River Wetland is included in this study because it is contiguous with White Lake, which is influenced by the water levels of Lake Michigan. The northern end of White Lake (adjacent to the wetland) has been dredged; dikes are also located in this area. The western portion of the wetland is non-wooded and the remainder is wooded. White River Wetland is a lower perennial Riverine System occupying a low site (U.S.G.S. quadrangle maps, Twin Lake, Michigan, 1958, and Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of White River Wetland is 60 feet; wetland elevations range from 580 to 640 feet above sea level, 0 to 60 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain; upland topography is rolling.

Surficial Geology

The surficial geology of White River Wetland is characterized by outwash and glacial channels. Outwash formations are made up of sorted and stratified material laid down by streams of glacial meltwater. These deposits consist of sand and gravel. Outwash and glacial channels are found in most of the White River Basin area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in White River Wetland is Kerston muck, a very poorly drained alluvial soil composed of layers of organic material alternating with mineral material. The surface layer is black muck underlain by layers of dominantly gray loose sand and dark gray muck. It has low natural fertility (Pregitzer, 1968).

Hydrology

The White River flows southwest through White River Wetland into White Lake. Numerous tributaries to the White River, including Carleton Creek, Silver Creek, Sand Creek, Cleveland Creek, Skeel Creek, and the North and South Branches of the White River, enter the wetland. The western part of the wetland is adjacent to White Lake (U.S.G.S. quadrangle map, Montague, Michigan, 1959).

The drainage area of the White River is 380 square miles and the average discharge is 422 cubic feet per second (U.S. Geological Survey, Water Resources Division 1977). The water quality of the White River is considered to be good, but White Lake has high nutrient levels and low levels of dissolved oxygen (Great Lakes Basin Commission, 1975). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for White River Wetland is located in Montague, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 19.8°F and the average daily high in July was 79.8°F. The average annual precipitation is 38.65 inches, with a mean monthly precipitation of 3.25 inches in January and 2.23 inches in July based on the normal period from 1941-1970. The growing season is approximately five months long, with the last killing frost (28°F) in 1975 occurring on May 16 and the first killing frost on October 11 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of White River Wetland (U.S.G.S. quadrangle maps, Twin Lake, Michigan, 1958, and Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 105

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of White River Wetland.

Fish

Species found in the low-gradient marshy area of the White River between its mouth and North Branch have included American brook lamprey (Lampetra lamottei), northern pike (Esox lucius), central mudminnow (Umbra limi), white sucker (Catostomus commersoni), redhorses (Moxostoma spp.), creek chub (Semotilus atromaculatus), common shiner (Notropis cornutus), bluntnose minnow (Pimephales notatus), yellow bullhead (Ictalurus natalis), burbot (Lota lota), johnny darter (Etheostoma nigrum), blackside darter (Percina maculata), logperch (Percina caprodes), yellow perch (Perca flavescens), largemouth bass (Micropterus salmoides), rock bass (Ambloplites rupestris), and mottled sculpin (Cottus bairdi). The burbot, yellow perch, johnny darter, mottled sculpin, central mudminnow, and American brook lamprey appear to be the most common species. Sport fishing has been pursued in this section of the White River, particularly dip-netting for suckers (Schultz, 1953). Since White Lake is a large recreational unit, more recent and detailed data on the fishes of the area

probably exist in unpublished files of the Michigan Department of Natural Resources. A search of the literature provided no site-specific information pertaining to spawning and hatching areas, seasonal locations and abundance, life histories, commercial use, or food sources of the fish populations in White River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in White River Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to White River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The section of White River Wetland lying west of U.S. Highway 31 was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance of inadequately protected high quality waterfowl areas (Martz, 1976). Preliminary data from this reconnaissance indicate that the primary function of the area is as a migration stopover and a breeding area for waterfowl. According to Jaworski and Raphael, (1978), White Lake is a concentration area for waterfowl during fall migration.

Appendices D-6 and D-7 contain general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to White River Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting White River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan

Endangered and Threatened Species Program, 1976) were documented in White River Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, a sewage disposal plant is located near the wetland and may have some effect on its health.

CULTURAL SETTING

LM 105

Population

White River Wetland is located in Whitehall Township of Muskegon County and in Otto Township of Oceana County, Michigan. Muskegon County has a moderate population density of 314 persons per square mile. Oceana County is sparsely populated, having a density of 34 persons per square mile. Table 4-31 indicates that the population of Muskegon County remained stable between 1970 and 1975, while Oceana County and Whitehall Township experienced a rapid rate of population growth during the same time period and Otto Township experienced a rapid decline. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable. Oceana County is expected to undergo continued rapid population growth.

Table 4-31. Population Data for the Vicinity of White River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	155,369
Whitehall Township	3,257	8.0	--
Oceana County	20,663	14.9	28,305
Otto Township	181	-7.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within White River Wetland is rural open space. The area surrounding the wetland is characterized by residential development near the southwest portion of the wetland, in the vicinity of the communities of Whitehall and Montague. The land surrounding the upriver portion of the wetland is primarily in agricultural and other rural open space uses, with scattered residences. A four-lane highway has been constructed through White River Wetland, and a sewage treatment plant is located to the south of the wetland.

Access roads and secondary highways are located in and near the wetland (U.S.G.S. quadrangle maps, Twin Lake, Michigan, 1958; Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974). Martz (1976) indicates that portions of White River Wetland may face development pressures in five or more years owing to residential encroachment.

Recreation

There are no known state or federal recreational facilities in the vicinity of White River Wetland.

Mineral, Energy, and Forest Resources

White River Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Gravel resources are also found in the vicinity of White River Wetland, and four large gravel pits are located on the southern border of the wetland near the Sand Creek basin (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Although the vicinity of White River Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915).

Portions of White River Wetland are wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1974), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

Transmission lines run through the western part of White River Wetland, and a sewage disposal plant is located south of the wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Pollution Sources

There are no NPDES permit holders adjacent to White River Wetland (Michigan Water Quality Division, 1978). However, a sewage disposal plant is located adjacent to the southwestern portion of the wetland (Agricultural Stabilization and Conservation Service aerial photograph, 1974). The extent and the nature of the impact (if any) of this public utility on White River Wetland are not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of White River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 105

The literature search identified no on-going or impending research projects pertaining to White River Wetland.

DUCK LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 106

Setting

Duck Lake Wetland is located near the eastern shoreline of Lake Michigan in Muskegon County, Michigan, 3.5 miles southwest of the community of Whitehall. Although it lies 1.5 miles from the Lake Michigan shoreline, Duck Lake Wetland is included in this study because it is contiguous with Duck Lake, which is influenced by the water levels of Lake Michigan. The wetland is a Lacustrine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Duck Lake Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain; the surrounding topography is low and rolling.

Surficial Geology

The surficial geology of Duck Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found throughout the Duck Lake area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Duck Lake Wetland is Houghton peat and muck, which has a surface layer of granular black muck underlain with mucky peat and fibrous peat. This organic soil is very poorly drained and has low natural fertility. Houghton muck developed in fibrous marsh grasses, sedges, and reeds (Pregitzer, 1968).

Hydrology

Duck Creek flows east through Duck Lake Wetland to Duck Lake. The wetland is adjacent to Duck Lake (U.S.G.S. quadrangle map, Montague, Michigan, 1959). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in this wetland.

Climate

The closest weather station providing climatic data for Duck Lake Wetland is located in Montague, Michigan. In 1975, the average monthly temperature was 46.3°F, the average daily low for January was 19.8°F and the average daily high

in July was 79.8⁰F. The average annual precipitation is 38.65 inches, with a mean monthly precipitation of 3.25 inches in January and 2.23 inches in July based on the normal period from 1941-1970. The growing season is approximately five months long, with the last killing frost (28⁰F) in 1975 occurring on May 16 and the first killing frost on October 11 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Duck Lake Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 106

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Duck Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Duck Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Duck Lake Wetland.

Reptiles and Amphibians

Appendix C-5 contains general information on the amphibians and reptiles of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Duck Lake Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-6 and D-7 contains general information on the wetland birds of Lake Section 4, but care should be exercised in the interpretation of the relevance of this information to Duck Lake Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density

and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Duck Lake Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Duck Lake Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 106

Population

Duck Lake Wetland is located in Fruitland Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 4-32 indicates that the population of Muskegon County remained stable between 1970 and 1975, while Fruitland Township experienced a rapid rate of population growth during the same time period. Projections for 1990 indicate that the population of Muskegon County will remain stable in the future.

Table 4-32. Population Data for the Vicinity of Duck Lake Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	155,369
Fruitland Township	3,385	5.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Duck Lake Wetland is rural open space. The surrounding area is primarily in agricultural and other rural open space uses. A secondary highway crosses through Duck Lake Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959; Agricultural Stabilization and Conservation Service aerial photograph, 1974). The wetland is under private ownership (West Michigan Shoreline Regional Development Commission, 1976), and lies within the area estimated to have average growth potential (West Michigan Shoreline Regional Development Commission, 1977). The immediate presence of agricultural land use surrounding the wetland, coupled with private ownership, may reflect low to moderate development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Duck Lake Wetland.

Mineral, Energy, and Forest Resources

Duck Lake Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing these resources (Gere, 1977). Although the vicinity of Duck Lake Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Duck Lake Wetland (U.S.G.S. quadrangle map, Montague, Michigan, 1959).

Pollution Sources

There are no NPDES permit holders adjacent to Duck Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Duck Lake Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 106

The literature search identified no on-going or impending research projects pertaining to Duck Lake Wetland.

Table 4-33. Data Gaps - Lake Section 4

Data Gap*		Wetland Number		076	077-079	080	081	082	083	084	085-086	087	088	089-090	091	092	094	095	096-098	099	100	101	102	103		
Physiographic Setting	Setting	Topography																								
		Surficial Geology																								
		Soils																								
		Hydrology	Water Level Fluctuations	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	Groundwater	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Water Quality	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Depth	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Changes	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
	Biotic Setting	Vegetation	Climax																							
			Special Features																							
		Fish	Major Species Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Major Species Composition	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Invertebrates	Major species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Species Composition			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Seasonal Distribution			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Spanning and Hatching Areas			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Amphibians/Reptiles	Commercial/Recreational Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Avifauna	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Mammals	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Endangered Species	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Cultural Setting	Health	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
	Population																									
	Land Use and Ownership																									
	Recreation																									
	Mineral, Energy, Forest Resource																									
	Public Utilities/Facilities																									
	Point Pollution Sources																									
	Non-Point Pollution Sources	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
Historic Features																										
Archaeologic Features	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			

Table 4-33. (concluded)

Data Gap*		Wetland Number	104	105	106
Physiographic Setting	Setting				
	Topography				
	Surficial Geology				
	Soils				
	Hydrology	Water Level Fluctuations	**	**	*
		Groundwater	**	*	*
		Water Quality	*	*	
		Depth	**	*	*
		Seasonal Changes	**	*	*
	Climate	Climate			
Special Features					
Biotic Setting	Vegetation	Major Species Distribution	*	*	*
		Major Species Composition	*	*	*
		Density/Productivity	*	*	*
		Relationship to Water Levels	*	*	*
	Fish	Major species	*	*	
		Species Composition	*	*	
		Seasonal Distribution	*	*	*
		Spawning and Hatching Areas	*	*	*
		Commercial/Recreational Use	*	*	*
		Life Histories	*	*	*
		Food Sources	*	*	*
	Invertebrates	Species Composition	*	*	*
		Seasonal Distribution	*	*	*
		Density/Productivity	*	*	*
		Food Sources	*	*	*
		Relationship to Water Levels	*	*	*
	Amphibians/Reptiles	Major Species	*	*	*
		Seasonal Distribution	*	*	*
		Density/Productivity	*	*	*
Recreational/Commercial Use		*	*	*	
Life Histories		*	*	*	
Food Sources		*	*	*	
Avifauna	Major Species	*	*	*	
	Seasonal Distribution	*	*	*	
	Density/Productivity	*	*	*	
	Recreational/Commercial Use	*	*	*	
	Life Histories	*	*	*	
	Food Sources	*	*	*	
	Relationship to Water Levels	*	*	*	
Mammals	Major Species	*	*	*	
	Seasonal Distribution	*	*	*	
	Density/Productivity	*	*	*	
	Recreational/Commercial Use	*	*	*	
	Life Histories	*	*	*	
	Food Sources	*	*	*	
	Relationship to Water Levels	*	*	*	
Cultural Setting	Endangered Species				
	Health	*	*	*	
	Population				
	Land Use and Ownership				
	Recreation				
	Mineral, Energy, Forest Resource				
	Public Utilities/Facilities				
	Point Pollution Sources				
	Non-Point Pollution Sources	*	*	*	
	Historic Features				
Archaeologic Features	*	*	*		

LAKE SECTION #5

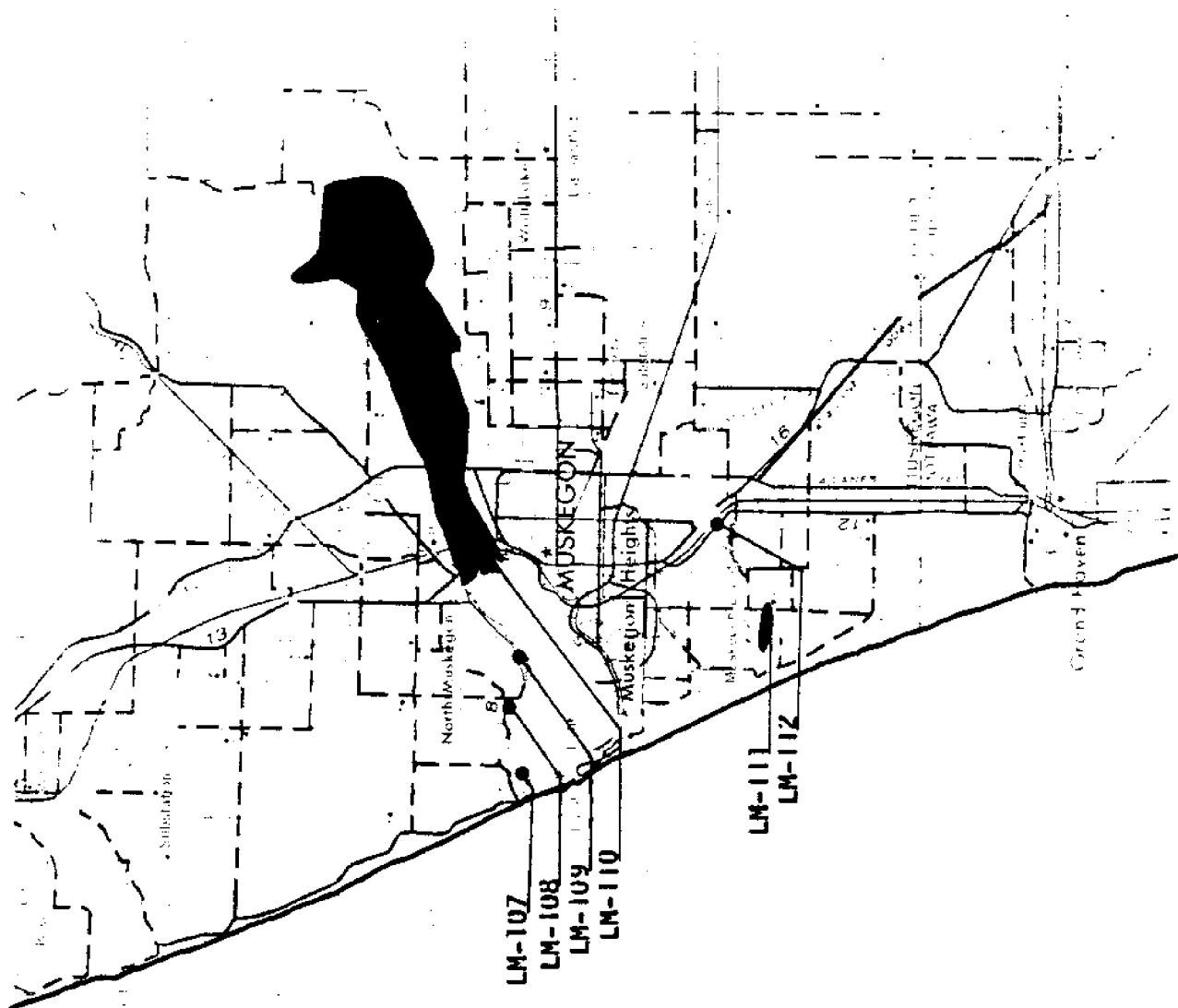
INTRODUCTION

Lake Section 5 extends along the eastern shoreline of Lake Michigan from the City of Muskegon, Michigan, to the Allegan County-Van Buren County border. The lake section is situated in Muskegon, Ottawa, and Allegan Counties. Many of the wetlands in Lake Section 5 lie more than 1,000 feet from the shoreline of Lake Michigan, but are included in this study because they are closely associated with bodies of water influenced by the levels of Lake Michigan. One of these wetlands, Muskegon River Wetland, is very large (6052 acres) and extends approximately 8.5 miles inland from Muskegon Lake.

All of the wetlands of Lake Section 5 are situated on a lacustrine plain. The topography surrounding these wetlands ranges from flat to rolling. High relief sand dunes are found in the vicinity of several of the wetlands and along most of the Lake Michigan shoreline of Section 5 (Great Lakes Basin Commission, 1975).

Figures 5-1 and 5-2 show the approximate location of the 12 wetlands in Lake Section 5. Latitude, longitude, acreage, and classification for each of these wetlands are presented in Table 5-1. Elevations of the wetlands range from 580 to 600 feet above sea level (lake level to 20 feet above the approximate mean elevation of Lake Michigan). Lacustrine and Riverine wetlands are prevalent in Lake Section 5. Several Palustrine Systems are also present.

Information related to the physiographic and cultural features of the wetlands is summarized in the individual wetland narratives presented in this chapter. Site-specific information on the biotic characteristics of these wetlands is lacking in most instances, but site-specific biotic data are available for Muskegon River Wetland. This wetland is one of the most intensively studied areas along the eastern shoreline of Lake Michigan, and is considered to be the best waterfowl area in Muskegon and Ottawa Counties (Martz, 1976).



LAKE MICHIGAN

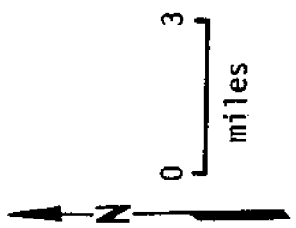


Figure 5-1. Lake Section 5 - Muskegon Area

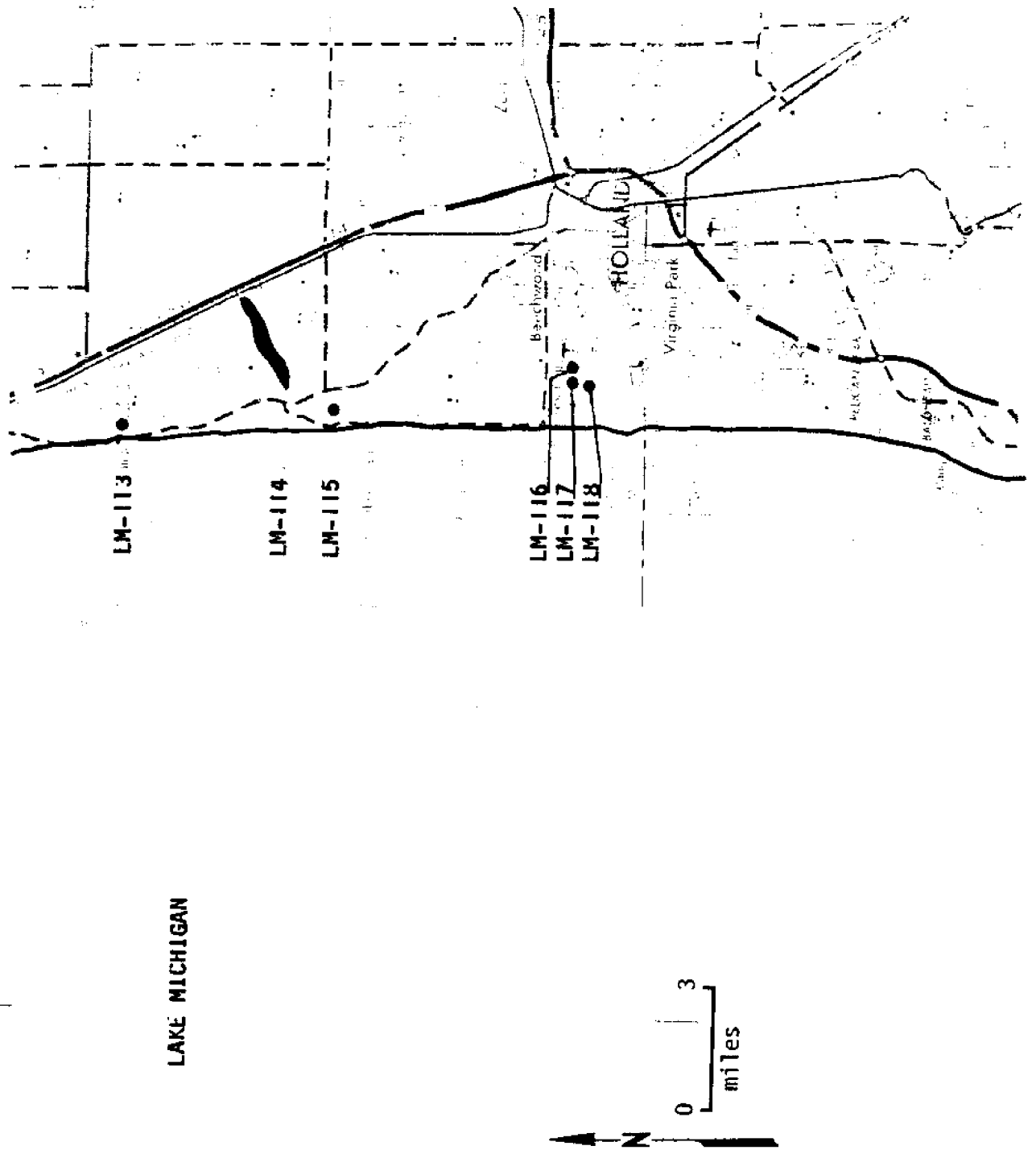


Figure 5-2. Lake Section 5 - Holland Area
-393-

Table 5-1. Location, Acreage, and Classification of Wetlands
in Lake Section 5

Wetland Number	Wetland	Latitude	Longitude	Acreage	Classification ^a
107	Devils Kitchen Wetland	43°14'43"	86°20'05"	3	L
108	Green Creek Wetland	43°15'00"	86°18'43"	6	R
109	Muskegon Lake Wetland	43°14'32"	86°17'03"	4	L
110	Muskegon River Wetland	43°16'40"	86°09'20"	6052	R
111	Norton Shores Wetland	43°10'00"	86°16'45"	22	L
112	Mona Lake Wetland	43°10'46"	86°13'22"	27	L
113	Little Pigeon Creek Wetland	43°57'53"	86°12'56"	42	L
114	Pigeon River Wetland	42°54'11"	86°10'54"	90	R
115	Sloan Pond Wetland	42°07'59"	86°12'26"	66	P,R
	BIG BAY WETLAND COMPLEX				
116	Big Bay Wetland #1	42°47'16"	86°11'23"	4	P
117	Big Bay Wetland #2	42°47'30"	86°11'30"	9	P
118	Big Bay Wetland #3	42°47'37"	86°11'09"	22	L,R

^aP=palustrine
L=lacustrine
R=riverine

DEVILS KITCHEN WETLAND

PHYSIOGRAPHIC SETTING

LM 107

Setting

Devils Kitchen Wetland is located 0.5 mile from the eastern shore of Lake Michigan in Muskegon County, Michigan. The wetland lies on the shoreline of Snug Harbor, an inlet of Muskegon Lake, within Muskegon State Park and 2.0 miles from the community of North Muskegon. Devils Kitchen Wetland is included in this study because Muskegon Lake is influenced by the water levels of Lake Michigan. It is likely that Muskegon Lake was a bay of Lake Michigan at one time, but the action of wind and waves has built a barrier of sand and gravel at the mouth of the embayment. Devils Kitchen Wetland is a Lacustrine System and occupies a low, partially wooded site (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Devils Kitchen Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a low lacustrine plain; high relief sand dunes are located nearby.

Surficial Geology

The surficial geology of Devils Kitchen Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along much of the Muskegon Lake shoreline (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Devils Kitchen Wetland is Marsh soil, which is wet throughout the year and consists of peat. The vegetation supported by Marsh soil includes cattails, sedges, water weeds, and water tolerant trees (Pregitzer, 1968).

Hydrology

Devils Kitchen Wetland is adjacent to Snug Harbor on Muskegon Lake. No streams flow through the wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972). Muskegon Lake has substandard water quality, owing to excessive levels of nutrients, coliform bacteria, suspended solids, oil films, toxic chemicals, and other industrial residues (Great Lakes Basin Commission, 1975). The effect of this substandard water quality on the wetland is unknown. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Devils Kitchen Wetland.

Climate

The closest weather station providing climatic data for Devils Kitchen Wetland is located in Muskegon, Michigan. In 1975, the average monthly temperature was 48.4°F, the average daily low for January was 22.4°F and the average daily high in July was 81.3°F. The average annual precipitation is 31.53 inches, with a mean monthly precipitation of 2.25 inches in January and 2.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Devils Kitchen Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 106

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Devils Kitchen Wetland.

Fish

An annual spring spawning run of walleyes (Stizostedion vitreum) occurs in the Muskegon River and is heavily exploited by anglers (Hubbs, 1933; Crowe, 1950; Crowe, 1953; Crowe, 1954). However, walleyes probably make little use of Devils Kitchen Wetland. At least 31 species have been collected in Muskegon Lake and are listed in Appendix A-2. Some of the more abundant or important species which may occur in Devils Kitchen Wetland include northern pike (Esox lucius), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), pumpkinseed (Lepomis gibbosus), carp (Cyprinus carpio), white sucker (Catostomus commersoni), bowfin (Amia calva), and longnose gar (Lepisosteus osseus). In 1951 the fish fauna of Muskegon Lake was abundant and diverse, and most fish were concentrated in the northern shoals of the lake. Marshy areas provided spawning habitat for yellow perch and northern pike. Other than walleyes, which are seasonal in abundance, major species taken by anglers included yellow perch, bluegill, rock bass, largemouth bass, smallmouth bass (Micropterus dolomieu), northern pike, pumpkinseed, black crappie, suckers (Moxostoma spp. and Catostomus commersoni), white bass (Morone chrysops), bowfin, channel catfish (Ictalurus punctatus), bullheads (Ictalurus spp.), and sauger (Stizostedion canadense). In 1951 industrial pollution affected fish life locally along the south shore, but was minimal elsewhere (Fukano, 1950; Peterson, 1951). Since Muskegon Lake is an important recreational unit, more recent data on the fish fauna of the lake and associated wetlands may exist in unpublished files of the Michigan Department of Natural

Resources. A search of the literature provided no site-specific information pertaining to life histories, commercial use, or food sources of the fish populations in Devils Kitchen Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Devils Kitchen Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Devils Kitchen Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The Mississippi Flyway Waterfowl Habitat Reconnaissance (Martz, 1976) included the Muskegon Lake area, from Lake Michigan to the Nowaygo County line. Although the reconnaissance focused on the large Muskegon River Wetland, its data may be applicable to Devils Kitchen Wetland because of the two wetlands' proximity and location on the same embayment. Work by Niegarth (1965) on a section of Muskegon River Wetland, particularly his study of the migratory bird population, may also be applicable to Devils Kitchen Wetland. This work is discussed in the avifauna section of Muskegon River Wetland (LM 110).

Devils Kitchen Wetland is included in the Muskegon Christmas Bird Count census area. An annotated summary of the 1972-76 counts is presented in Appendix D-8. Since the census area includes sizeable urban, open water, and upland areas, in addition to several other wetlands, care should be exercised in the interpretation of the relevance of these counts to Devils Kitchen Wetland. The most consistently abundant birds observed during these winter censuses were common mergansers (Mergus merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Devils Kitchen Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Devils Kitchen Wetland by the literature search. However the bald eagle (Haliaeetus leucocephalus) and the osprey (Pandion haliaetus) are occasionally seen in the Muskegon Lake area (Mantz, 1976). Both are threatened species in Michigan.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 106

Population

Devils Kitchen Wetland is located in Laketon Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 5-2 indicates that the population of Muskegon County remained stable between 1970 and 1975, but Laketon Township experienced a rapid rate of population growth during the same time period. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable.

Table 5-2. Population Data for the Vicinity of Devils Kitchen Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	155,369
Laketon Township	5,723	5.2	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Devils Kitchen Wetland and the surrounding area is rural open space. A boat canal connecting Lake Michigan and Muskegon Lake is located less than one mile south of Devils Kitchen Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974). The wetland is under state ownership (Muskegon State Park), and its location suggests that it is subject to minimal development pressure (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972, West Michigan Shoreline Regional Development Commission, 1977).

Recreation

Devils Kitchen Wetland is located within the 1,125-acre Muskegon State Park. Recreational uses of the park include swimming, fishing, boating, picnicking, and hiking (Michigan Department of Natural Resources, 1978).

Mineral, Energy, and Forest Resources

Devils Kitchen Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing this resource (Gere, 1977). The wetland is situated near coastal sand dune areas, and dune and coastal strip sands are the leading sources of industrial quality sand, owing to their purity and superior physical capabilities (Michigan Geological Survey, 1975). It is unlikely, however, that this sand will be mined due to its location within Muskegon State Park. Gravel resources are also found in the vicinity of the wetland, but no active gravel operations are present (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Although the area in the vicinity of Devils Kitchen Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Devils Kitchen Wetland is partially wooded (Agricultural Stabilization and Conservation Service aerial photograph, 1974), but it is unlikely that this wooded area in the state park will be used for commercial production.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Devils Kitchen Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Devils Kitchen Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Devils Kitchen Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 107

The literature search identified no on-going or impending research projects pertaining to Devils Kitchen Wetland.

GREEN CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 108

Setting

Green Creek Wetland is situated in Muskegon County, Michigan, 1.1 miles west of the community of North Muskegon. Although Green Creek Wetland lies 1.8 miles from the Lake Michigan shoreline, it is included in this study because it is within 1,000 feet of Muskegon Lake, which is influenced by the water levels of Lake Michigan. The wetland lies on either side of Green Creek, which flows southward into Muskegon Lake. Green Creek Wetland is a Lower Perennial Riverine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Green Creek Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a low lacustrine plain; high relief sand dunes are located nearby.

Surficial Geology

The surficial geology of Green Creek Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along much of the Muskegon Lake shoreline (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Green Creek Wetland is Houghton muck and peat, which consists of a surface layer of granular black muck underlain with mucky peat and fibrous peat. This organic soil is very poorly drained and has low natural fertility. Houghton muck developed from fibrous marsh grasses, sedges, and reeds (Pregitzer, 1968).

Hydrology

Green Creek flows through Green Creek Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Green Creek Wetland.

Climate

The closest weather station providing climatic data for Green Creek Wetland is located in Muskegon, Michigan. In 1975, the average monthly

temperature was 48.4⁰F, the average daily low for January was 22.4⁰F and the average daily high in July was 81.3⁰F. The average annual precipitation is 31.53 inches, with a mean monthly precipitation of 2.25 inches in January and 2.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28⁰F) in 1975 occurring on April 21 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Green Creek Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 108

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Green Creek Wetland.

Fish

An annual spring spawning run of walleyes (Stizostedion vitreum) occurs in the Muskegon River and is heavily exploited by anglers (Hubbs, 1933; Crowe, 1950; Crowe, 1953; Crowe, 1954). However, walleyes probably make little use of Muskegon Lake Wetland #1. At least 31 species have been collected in Muskegon Lake and are listed in Appendix A-2. Some of the more abundant or important species which may occur in Muskegon Lake Wetland #1 include northern pike (Esox lucius), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), pumpkinseed (Lepomis gibbosus), carp (Cyprinus carpio), white sucker (Catostomus commersoni), bowfin (Amia calva), and longnose gar (Lepisosteus osseus). In 1951 the fish fauna of Muskegon Lake was abundant and diverse, and most fish were concentrated in the northern shoals of the lake. Marshy areas provided spawning habitat for yellow perch and northern pike. Other than walleyes, which are seasonal in abundance, major species taken by anglers included yellow perch, bluegill, rock bass, largemouth bass, smallmouth bass (Micropterus dolomieu), northern pike, pumpkinseed, black crappie, suckers (Moxostoma spp. and Catostomus commersoni), white bass (Morone chrysops), bowfin, channel catfish (Ictalurus punctatus), bullheads (Ictalurus spp.), and sauger (Stizostedion canadense). In 1951 industrial pollution affected fish life locally along the south shore, but was minimal elsewhere (Fukano, 1950; Peterson, 1951). Since Muskegon Lake is an important recreational unit, more recent data on the fish fauna of the lake and associated wetlands may exist in unpublished files of the Michigan Department of Natural Resources. A search of the literature provided no site-specific information pertaining to life histories, commercial use, or food sources of the fish populations in Green Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Green Creek Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Green Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The Mississippi Flyway Waterfowl Habitat Reconnaissance (Martz, 1976) included the Muskegon Lake area, from Lake Michigan to the Nowaygo County line. Although the reconnaissance focused on the large Muskegon River Wetland, its data may be applicable to Green Creek Wetland because of the two wetlands' proximity and location on the same embayment. Work by Niegarth (1965) on a section of Muskegon River Wetland, particularly his study of the migratory bird population, may also be applicable to Green Creek Wetland. This work is discussed in the avifauna section of Muskegon River Wetland (LM 110).

Green Creek Wetland is included in the Muskegon Christmas Bird Count census area. An annotated summary of the 1972-76 counts is presented in Appendix D-8. The census area includes sizeable urban, open water, and upland areas, in addition to several other wetlands included in this study, so care should be exercised in the interpretation of the relevance of these counts to Green Creek Wetland. The most consistently abundant birds observed during these winter censuses were common mergansers (Mergus merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Green Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Green Creek Wetland by the literature search. However the bald eagle (*Haliaeetus leucocephalus*) and the osprey (*Pandion haliaetus*) are occasionally seen in the Muskegon Lake area (Martz, 1976). Both are threatened species in Michigan.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 108

Population

Green Creek Wetland lies near the city of North Muskegon in Muskegon Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 5-3 indicates that the populations of Muskegon County, Muskegon Township, and the city of Muskegon were stable between 1970 and 1975. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable.

Table 5-3. Population Data for the Vicinity of Green Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	157,369
Muskegon Township	44,176	-1.0	--
City of Muskegon	44,176	-1.0	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Green Creek Wetland is urban open space. The surrounding area is characterized by low density residential development, with limited agricultural open space uses inland from Muskegon Lake. A secondary highway lies adjacent to the southern portion of Green Creek Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and

Conservation Service aerial photograph, 1974). The wetland is under private ownership (West Michigan Shoreline Regional Development Commission, 1977), and its location suggests that it is subject to high development pressures.

Recreation

There are no known state or federal recreational facilities in Green Creek Wetland.

Mineral, Energy, and Forest Resources

Green Creek Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing this resource (Gere, 1977). Although the area in the vicinity of Green Creek Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Green Creek Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Green Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Green Creek Wetland, nor are there any known archaeological sites in the vicinity, however, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 108

The literature search identified no on-going or impending research projects pertaining to Green Creek Wetland.

MUSKEGON LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 109

Setting

Muskegon Lake Wetland is situated in Muskegon County, Michigan, 0.1 mile south of the community of North Muskegon. Although it lies three miles east of the Lake Michigan shoreline, Muskegon Lake Wetland is included in this study because it is contiguous with Muskegon Lake, which is influenced by the water levels of Lake Michigan. A portion of this wetland is submerged in Muskegon Lake. Muskegon Lake Wetland is a Lacustrine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Muskegon Lake Wetland is 5 feet; wetland elevations range from 580 to 585 feet above sea level, 0 to 5 feet above the approximate mean elevation of Lake Michigan. Muskegon Lake Wetland is situated on a lacustrine plain surrounded by rolling morainal topography.

Surficial Geology

The surficial geology of Muskegon Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along much of the Muskegon Lake shoreline (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil types in Muskegon Lake Wetland are Roscommon and Au Gres sands. These sandy soils are deep and poorly drained, with a surface layer of dark gray to black granular sand. Roscommon and Au Gres sands have low natural fertility and low available moisture capacity, and are wet most of the time (Pregitzer, 1968).

Hydrology

Muskegon Lake Wetland is adjacent to Muskegon Lake, but no streams flow through the wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972). Muskegon Lake has substandard water quality, owing to excessive levels of nutrients, coliform bacteria, suspended solids, oil films, toxic chemicals, and other industrial residues (Great Lakes Basin Commission, 1975). The effect of this substandard water quality on the wetland is unknown. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Muskegon Lake Wetland.

Climate

The closest weather station providing climatic data for Muskegon Lake Wetland is located in Muskegon, Michigan. In 1975, the average monthly temperature was 48.4°F, the average daily low for January was 22.4°F and the average daily high in July was 81.3°F. The average annual precipitation is 31.53 inches, with a mean monthly precipitation of 2.25 inches in January and 2.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Muskegon Lake Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 109

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Muskegon Lake Wetland.

Fish

An annual spring spawning run of walleyes (Stizostedion vitreum) occurs in the Muskegon River and is heavily exploited by anglers (Hubbs, 1933; Crowe, 1950; Crowe, 1953; Crowe, 1954). However, walleyes probably make little use of Muskegon Lake Wetland #1. At least 31 species have been collected in Muskegon Lake and are listed in Appendix A-2. Some of the more abundant or important species which may occur in Muskegon Lake Wetland #1 include northern pike (Esox lucius), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), pumpkinseed (Lepomis gibbosus), carp (Cyprinus carpio), white sucker (Catostomus commersoni), bowfin (Amia calva), and longnose gar (Lepisosteus osseus). In 1951 the fish fauna of Muskegon Lake was abundant and diverse, and most fish were concentrated in the northern shoals of the lake. Marshy areas provided spawning habitat for yellow perch and northern pike. Other than walleyes, which are seasonal in abundance, major species taken by anglers included yellow perch, bluegill, rock bass, largemouth bass, smallmouth bass (Micropterus dolomieu), northern pike, pumpkinseed, black crappie, suckers (Moxostoma spp. and Catostomus commersoni), white bass (Morone chrysops), bowfin, channel catfish (Ictalurus punctatus), bullheads (Ictalurus spp.), and sauger (Stizostedion canadense). In 1951 industrial pollution affected fish life locally along the south shore, but was minimal elsewhere (Fukano, 1950; Peterson, 1951). Since Muskegon Lake is an important recreational unit, more recent data on the fish fauna of the lake and associated wetlands may exist in unpublished files of the Michigan Department of Natural

Resources. A search of the literature provided no site-specific information pertaining to life histories, commercial use, or food sources of the fish populations in Muskegon Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Muskegon Lake Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Muskegon Lake Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

The Mississippi Flyway Waterfowl Habitat Reconnaissance (Martz, 1976) included the Muskegon Lake area, from Lake Michigan to the Nowaygo County line. Although the reconnaissance focused on the large Muskegon River Wetland, its data may be applicable to Muskegon Lake Wetland because of the two wetlands' proximity and location on the same embayment. Work by Niegarth (1965) on a section of Muskegon River Wetland, particularly his study of the migratory bird population, may also be applicable to Muskegon Lake Wetland. This work is discussed in the avifauna section of Muskegon River Wetland (LM 110).

Muskegon Lake Wetland is included in the Muskegon Christmas Bird Count census area. An annotated summary of the 1972-76 counts is presented in Appendix D-8. Since the census area includes sizeable urban, open water, and upland areas, in addition to several other wetlands, care should be exercised in the interpretation of the relevance of these counts to Muskegon Lake Wetland. The most consistently abundant birds observed during these winter censuses were common mergansers (Mergus merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Muskegon Lake Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Muskegon Lake Wetland by the literature search. However the bald eagle (Haliaeetus leucocephalus) and the osprey (Pandion haliaetus), both threatened species in Michigan, are known to be occasional users of the Muskegon Lake area (Martz, 1976).

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 109

Population

Muskegon Lake Wetland lies near the city of North Muskegon in Muskegon Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 5-4 indicates that the populations of Muskegon County, Muskegon Township, and the City of Muskegon were stable between 1970 and 1975. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable.

Table 5-4. Population Data for the Vicinity of Muskegon Lake Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	157,369
Muskegon Township	44,176	-1.0	--
City of Muskegon	44,176	-1.0	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Muskegon Lake Wetland is urban open space. The surrounding area along the northern shore of Muskegon Lake is in residential and commercial development (Agricultural Stabilization and Conservation Service aerial photograph, 1976). The wetland is under private ownership, and the extent of surrounding residential development suggests that development pressures may be high.

Recreation

There are no known state or federal recreational facilities in Muskegon Lake Wetland.

Mineral, Energy, and Forest Resources

Muskegon Lake Wetland lies within an area of Silurian salt deposits. However, there are no operations in or near the wetland utilizing this resource (Gere, 1977). Although the area in the vicinity of Muskegon Lake Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Muskegon Lake Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Muskegon Lake Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Muskegon Lake Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 109

The literature search identified no on-going or impending research projects pertaining to Muskegon Lake Wetland.

MUSKEGON RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 110

Setting

Muskegon River Wetland is located in Newaygo and Muskegon Counties, Michigan, in the floodplain of the Muskegon River adjacent to the city of Muskegon. Muskegon River Wetland is 4.5 miles from the Lake Michigan shoreline, but it is included in this study because it is contiguous with Muskegon Lake, which is influenced by the water levels of Lake Michigan. The wetland extends from Muskegon Lake inland for a distance of approximately 8.5 miles. Lower elevations within the wetland are non-wooded, while higher elevations are wooded. Muskegon River Wetland is a Lower Perennial Riverine System. Portions of the wetland are within the Muskegon State Game Area (U.S.G.S. quadrangle map, Twin Lake, Michigan, 1958).

Topography

The total relief of Muskegon River Wetland is 20 feet; wetland elevations range from 580 to 600 feet above sea level, 0 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on either side of the Muskegon River; bluff lines, approximately 40 to 80 feet high, mark the northern and southern extent of the floodplain. The wetland lies on a low lacustrine plain and the upland topography is rolling.

Surficial Geology

The surficial geology of Muskegon River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found throughout the Muskegon area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Muskegon River Wetland consists mainly of Kerston muck along the Muskegon River, but areas of Tawas and Carlisle mucks are also present. The latter are very poorly drained organic soils, with a surface layer of black muck over peaty muck and peat, underlain by gray, loose-grained sand. Tawas and Carlisle mucks have high available moisture capacity. Kerston muck is an organic alluvial soil which ranges from a nearly pure organic soil to muck or peat with mineral soil mixed in. This soil is very poorly drained (Pregitzer, 1968).

Hydrology

The Muskegon River flows west through Muskegon River Wetland into Muskegon Lake. The Muskegon River has numerous tributaries which flow through the wetland, including the North and Middle Channels of the Muskegon River, Cedar Creek, Little Cedar Creek, Spring Creek, Mosquito Creek, Maple River, and

Sweeter Creek, as well as several unnamed perennial streams. The western portion of Muskegon River Wetland is adjacent to Muskegon Lake (U.S.G.S. quadrangle map, Twin Lake, Michigan, 1958). Water quality and hydrologic data, sampled upstream from the wetland, are available (U.S. Geological Survey, Water Resources Division, 1977). The water quality of the Muskegon River basin is considered to be generally good. However, Muskegon Lake has substandard water quality owing to excessive levels of nutrients, coliform bacteria, suspended solids, oil films, toxic chemicals, and other industrial residues (Great Lakes Basin Commission, 1975). The effect of this substandard water quality on the wetland is unknown. The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Muskegon River Wetland.

Climate

The closest weather station providing climatic data for Muskegon River Wetland is located in Muskegon, Michigan. In 1975, the average monthly temperature was 48.4°F, the average daily low for January was 22.4°F and the average daily high in July was 81.3°F. The average annual precipitation is 31.53 inches, with a mean monthly precipitation of 2.25 inches in January and 2.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Muskegon River Wetland (U.S.G.S. quadrangle map, Twin Lake, Michigan, 1958).

BIOTIC SETTING

LM 110

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Muskegon River Wetland.

Fish

An annual spring spawning run of walleyes (Stizostedion vitreum) occurs in the Muskegon River and is heavily exploited by anglers (Hubbs, 1933; Crowe, 1950; Crowe, 1953; Crowe, 1954). However, walleyes probably make little use of Muskegon Lake Wetland #1. At least 31 species have been collected in Muskegon Lake and are listed in Appendix A-2. Some of the more abundant or important species which may occur in Muskegon Lake Wetland #1 include northern pike (Esox lucius), largemouth bass (Micropterus salmoides), yellow perch (Perca flavescens), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), pumpkinseed (Lepomis gibbosus), carp (Cyprinus carpio), white sucker (Catostomus commersoni), bowfin (Amia calva), and longnose gar (Lepisosteus osseus). In 1951 the fish fauna of Muskegon Lake was abundant and

diverse, and most fish were concentrated in the northern shoals of the lake. Marshy areas provided spawning habitat for yellow perch and northern pike. Other than walleyes, which are seasonal in abundance, major species taken by anglers included yellow perch, bluegill, rock bass, largemouth bass, smallmouth bass (Micropterus dolomieu), northern pike, pumpkinseed, black crappie, suckers (Moxostoma spp. and Catostomus commersoni), white bass (Morone chrysops), bowfin, channel catfish (Ictalurus punctatus), bullheads (Ictalurus spp.), and sauger (Stizostedion canadense). In 1951 industrial pollution affected fish life locally along the south shore, but was minimal elsewhere (Fukano, 1950; Peterson, 1951). Since Muskegon Lake is an important recreational unit, more recent data on the fish fauna of the lake and associated wetlands may exist in unpublished files of the Michigan Department of Natural Resources. A search of the literature provided no site-specific information pertaining to life histories, commercial use, or food sources of the fish populations in Muskegon River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Muskegon River Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Muskegon River Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Muskegon River Wetland, along with open water sections of Bear Lake and Muskegon Lake, was included in the Mississippi Flyway Waterfowl Habitat Reconnaissance of inadequately protected high quality waterfowl areas (Martz, 1976). Estimated waterfowl production and migration data from this evaluation are presented in Table 5-5. This wetland is considered to be the best waterfowl area in Muskegon and Ottawa Counties. The reconnaissance indicated that there are great blue heron (Ardea herodias) rookeries present. There is occasional use of the wetland by bald eagles (Haliaeetus leucocephalus) and ospreys (Pandion haliaetus); the area is a potential nesting site for both species (Martz, 1976). The Muskegon River mouth is also important for passerine, hawk, and shorebird migration (Jaworski and Raphael, 1977).

A study of the resident and migratory bird populations on a section of Muskegon River Wetland was made by Niegarth (1965) during the period from August 15, 1962, to July 15, 1963. The 65-acre study area was located directly east of Highway 31 (Township 10N, Range 16W, Section 17). The migration study included both observation and banding with the use of mist nets. Table 5-6 lists the

Table 5-5. Estimated Waterfowl Production and Migration of the Muskegon River Wetland^a

Species	Avg density (prs/sq mi)	Avg young/ wetland acre	Avg peak pop. (000's)	Avg fall pop. (000's)	Avg duration (no. weeks)	Avg peak pop. (000's)	Avg wintering pop. (000's)	Avg duration (no. weeks)
DUCKS								
mallard	56	.26	7.0	4.0	4	0.5	0.3	3
black duck	8	.03	1.0	0.6	4	0.1	0.1	3
gadwall			0.5		1			
green-winged teal			3.0	2.0	2			
blue-winged teal	10	.05	4.0	2.5	2			
pintail			0.5	0.1	3			
wood duck	40	.20	4.0	3.0	3			
<u>Sub-Dabblers</u>	<u>114</u>	<u>.54</u>	<u>20.0</u>	<u>12.1</u>		<u>0.6</u>	<u>0.4</u>	
redhead			0.2	0.1	3			
canvasback			0.2	0.1	3			
scaup spp.			4.0	2.0	4	0.5	0.2	4
ring-necked duck			1.5	1.0	3	0.3	0.1	4
common goldeneye/ bufflehead			0.3	0.2	2	0.1	0.1	6
ruddy duck			0.1	0.1	2			
<u>Sub-Divers</u>	<u>—</u>	<u>—</u>	<u>6.3</u>	<u>3.5</u>		<u>0.9</u>	<u>0.4</u>	
Total Ducks	114	.54	26.3	15.6		1.5	0.8	
GEESE								
snow goose			0.2	0.1	1			
Canada goose			0.4	0.2	2			
<u>Total Geese</u>	<u>—</u>	<u>—</u>	<u>0.6</u>	<u>0.3</u>		<u>—</u>	<u>—</u>	
SWANS								
whistling swan			0.1	0.1	1			
<u>Total Swans</u>	<u>—</u>	<u>—</u>	<u>0.1</u>	<u>0.1</u>		<u>—</u>	<u>—</u>	
<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>		<u>—</u>	<u>—</u>	
<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>	<u>—</u>		<u>—</u>	<u>—</u>	
Total Anatidae	114	.54	27.0	16.0		1.5	0.8	

^aMartz (1976)

Table 5-6. Seasonal Distribution of Birds in the Muskegon River Wetland During the Period September 1, 1962, through July 15, 1963^a

Species	Sept.	Wint.	Mar.	Apr.	May	June	July	Arrival Date
pied-billed grebe			x	x				March 27
great blue heron			x	x	x	x		March 30
green heron	x			x	x	x	x	April 24
black-crowned night heron	x							
least bittern					x	x		May 5
American bittern				x	x	x		April 6
Canada goose			x					March 16
mallard	x		x	x	x	x		
black duck			x	x	x			
pintail				x				
blue-winged teal	x		x	x	x	x	x	
shoveler				x				April 23
scaup spp.		x	x					
common goldeneye		x	x					
bufflehead		x	x					
common merganser		x	x					
marsh hawk				x	x			April 11
ring-necked pheasant		x		x	x			
Virginia rail				x	x			April 25
sora				x	x	x		April 19
common gallinule				x	x	x		April 20
American coot			x	x				March 27
killdeer	x		x	x				March 27
common snipe				x	x	x		April 6
spotted sandpiper					x	x		May 15
greater yellowlegs				x				April 23
lesser yellowlegs				x				April 23
herring gull	x	x	x	x	x			
black tern					x	x	x	May 4
mourning dove			x					
common nighthawk					x			May 30
chimney swift					x	x		May 6
ruby-throated hummingbird						x		June 8
belted kingfisher	x			x	x	x	x	April 6
common flicker	x		x	x	x	x	x	March 30
red-headed woodpecker				x				April 27
downy woodpecker		x			x	x		
eastern phoebe	x							
Trail's flycatcher					x			May 18
least flycatcher					x	x		May 8
horned lark		x	x					
tree swallow	x		x	x	x	x	x	March 30

(Continued)

Table 5-6. (Continued)

Species	Sept.	Wint.	Mar.	Apr.	May	June	July	Arrival Date
bank swallow	x				x			May 1
rough-winged swallow								May 1
barn swallow				x	x	x	x	April 19
purple martin				x	x	x		April 23
blue jay	x	x						
common crow		x	x	x	x	x	x	
long-billed marsh wren	x				x	x	x	May 5
mockingbird			x					
catbird	x				x	x	x	May 5
brown thrasher	x			x	x			April 19
robin			x	x	x	x	x	March 30
hermit thrush				x				April 24
Swainson's thrush					x			May 8
gray-cheeked thrush					x			May 10
veery					x			May 10
ruby-crowned kinglet				x	x			April 23
cedar waxwing	x				x	c		May 9
starling	x	x	x	x	x	x		
black and white warbler					x			May 18
orange-crowned warbler	x							
Nashville warbler					x			May 18
yellow warbler					x	x	x	May 4
magnolia warbler					x			May 18
myrtle warbler	x				x			May 23
chestnut-sided warbler					x			May 8
bay-breasted warbler					x			May 25
blackpoll warbler					x			May 15
ovenbird					x			May 18
yellowthroat	x				x	x	x	May 4
Wilson's warbler	x				x			May 24
Canada warbler					x			May 30
eastern meadowlark			x					
red-winged blackbird			x	x	x	x	x	March 16
northern oriole					x	x		May 11
common grackle	x		x	x	x	x	x	March 23
brown-headed cowbird			x	x	x	x	x	March 30
scarlet tanager					x			May 29
cardinal	x	x		x	x			
rose-breasted grobeak						x		June 1
American goldfinch	x				x	x	x	May 11
rufus-sided towhee				x				April 29
slate-colored junco		x	x					
tree sparrow		x		x				
chipping sparrow		x		x				May 31
white-crowned sparrow				x	x	x		April 25

(Continued)

Table 5-6. (Concluded)

Species	Sept.	Wint.	Mar.	Apr.	May	June	July	Arrival Date
white-throated sparrow				x	x	x		April 19
fox sparrow				x				April 19
Lincoln's sparrow					x			May 4
swamp sparrow	x			x	x	x	x	April 1
song sparrow	x		x	x	x	x	x	March 16

^aNiegarth (1065)

species observed from September 1, 1962, to July 15, 1963. Swamp sparrows (Melospiza georgiana) were the birds most commonly observed in the wetland area. Red-winged blackbirds (Agelaius phoeniceus) and long-billed marsh wrens (Cistothorus palustris) were numerous. Least bitterns (Ixobrychus exilis), soras (Porzana carolina), green herons (Butorides striatus), and common grackles (Quiscalus quiscula) were next in abundance. Along the willow edges of the study area, common birds were white-throated sparrows (Zonotrichia albicollis), white-crowned sparrows (Z. leucophrys), and song sparrows (Melospiza melodia). Common flickers (Colaptes auratus), yellow warblers (Dendroica petechia), yellowthroats (Geothlypis trichas), and catbirds (Dumetella carolinensis) were also seen frequently.

Forty-two species of birds, totaling 393 individuals, were banded by Niegarth. The most frequently banded birds were swamp sparrows (82), Lincoln's sparrows (Melospiza lincolni) (44), white-throated sparrows (29), red-winged blackbirds (26), song sparrows (25), and catbirds (25). May was the most productive month for banding, with 308 individuals or 0.97 birds per net hour. April was the next most productive, with 55 individuals or 0.30 birds per net hour. A total of 93 species were observed or banded during the study.

Niegarth found that red-winged blackbirds, swamp sparrows, and long-billed marsh wrens were the major nesting species in this section of Muskegon River Wetland. Data from the nesting study, during which 34 active nests of seven species were observed, are summarized in Table 5-7.

Red-winged blackbirds and swamp sparrows reached the peak of their egg laying in late May; the peak for long-billed marsh wrens occurred in mid-June. One abandoned red-winged blackbird egg with a small hole in it was observed, possibly indicating marsh wren predation. Two long-billed marsh wren nests were found to be destroyed. Bonaparte's weasel and the jumping mouse, two suspected predators on long-billed marsh wren nests, were known to be present in the study area.

Niegarth determined a nesting density of 1.7 nests per acre for all species observed in the study area, which was somewhat lower than expected. However, each of the three major nesting species showed significantly higher nesting densities in their preferred nesting habitat than the figures in Table 5-7 would indicate. While the density of red-winged blackbird nests was 0.8/acre over the entire study area, the density was 2.3 nests/acre in areas that were exclusively cattail. In addition, it was noted that during the winter of 1962-1963, heavy snowfall caused the flattening of the dry cattails of the previous year, reducing the nesting habitat for some wetland species. Water levels in the Muskegon River were below normal in the summer of 1963, which may have affected production.

Portions of Muskegon River Wetland lie within Muskegon River State Game Area. Waterfowl hunting in the area is not considered to be of high quality (Michigan Department of Natural Resources, 1974).

Christmas Bird counts are available for the Muskegon census area, which includes a section of the Muskegon River Wetland. An annotated summary of the 1972-76 counts is presented in Appendix D-8. Common mergansers (Mergus

Table 5-7. Nesting Success on Eight 2.5 Acre Plots in Muskegon River Wetland^a

Species	Number of nests	Predominate nesting substrate	Nest density (nests/acre)	Nesting success (young produced/eggs laid)
red-winged blackbird	16	cattails	0.8	33.3% (19/57)
swamp sparrow	8	grasses	0.4	25% (9/36)
long-billed marsh wren	5	cattails	0.25	60% (15/25)
least bittern	2	cattails		
common grackle	1	cattails		
song sparrow	1	cattails		
mallard	1	grassy		
All Species	34		1.7	

^aWiegarth (1965)

merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos) were the most consistently abundant birds during these counts. Since the census area also includes upland and urban areas, care should be exercised in the interpretation of the relevance of these data to Muskegon River Wetland.

The literature search provided no site-specific information pertaining to commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

Muskegon River Wetland is exceptionally good habitat for muskrat (Ondatra zibethicus) (Jaworski and Raphael, 1978). The literature search provided no site-specific data pertaining to other major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Muskegon River Wetland.

Endangered Species

The marsh hawk (Circus cyaneus) and the osprey, both threatened species in Michigan (Michigan Endangered and Threatened Species Program, 1976), have been reported in Muskegon River Wetland, as have the rare black-crowned night heron (Nycticorax nycticorax) and American bittern (Botaurus lentiginosus) (Niegarth, 1965). Bald eagles, which are on the federal list of endangered species (U.S. Fish and Wildlife Service, 1978), use the wetland occasionally. No other plants or animals appearing on the federal or state lists of endangered or threatened species were documented in Muskegon River Wetland by the literature search.

Health

Site-specific information indicates that the environmental quality of Muskegon River Wetland is good for avifauna. However, oil wells, a power plant and a sewage disposal plant are located in or near the wetland and may have some effect on its health.

CULTURAL SETTING

LM 110

Population

Muskegon River Wetland is situated adjacent to the city of Muskegon in Egelston and Muskegon Townships of Muskegon County, and reaches into Cedar Creek Township of Newaygo County. Muskegon County has a moderate population density of 314 persons per square mile. Table 5-8 indicates that the population of Muskegon County, Muskegon Township, Egelston Township, and the city of Muskegon were stable between 1970 and 1975. Newaygo County and Cedar Creek Township experienced rapid growth during the same time period. Projections for 1990 indicate that the population of Muskegon County will remain stable.

Table 5-8. Population Data for the Vicinity of Muskegon River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	155,369
Muskegon Township	44,176	-1.0	--
Egelston Township	6,657	-0.5	--
City of Muskegon	44,176	-1.0	--
Newaygo County	31,244	11.6	--
Cedar Creek Township	1,763	20.2	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Muskegon River Wetland is primarily rural open space. A primary highway crosses Muskegon River Wetland near the point at which the Muskegon River flows into Muskegon Lake. A rail line also crosses the wetland near this point. Oil wells are located within the wetland (U.S.G.S. quadrangle map, Twin Lake, Michigan, 1958). An area of residential, industrial, and commercial development (the city of Muskegon) surrounds the eastern portion of the wetland, with the area south of the wetland generally receiving more intensive use. Uses further inland become less intensive, with agricultural and other rural open space uses predominating (Abrams Aerial Survey Corp., undated). Muskegon River Wetland is under mixed state, local, corporate, and private ownership (Rockford Map Publishers, Inc., 1975).

According to Martz (1976), portions of Muskegon River Wetland face potential destruction in the next five years. Fly-ash dumping, municipal and industrial fill, petrochemical storage tank leakage, marina development, pollution from shipping, agricultural development and runoff, channelization, potential wastewater from treatment plants to the east, and county park development will be the contributing factors to this destruction. In 1975, the city of Muskegon agreed to limit their sanitary filling of the wetland to that area which represents impatented upland (Michigan Department of Natural Resources, personal communication).

Recreation

Muskegon River Wetland is partially located within the Muskegon River State Game Area. The major recreational use of this area is fishing, for which the Muskegon River is the primary site. Other activities include hunting and trapping. Waterfowl hunting in the area is not considered to be of high quality (Michigan Department of Natural Resources, 1974).

Mineral, Energy, and Forest Resources

Muskegon River Wetland lies within an area of Silurian salt deposits, but there are no operations in or near the wetland utilizing this resource (Gere, 1977). Gravel resources are also found in the vicinity of Muskegon River Wetland; a large gravel pit is located in the eastern portion of the wetland near Little Cedar Creek.

The vicinity of Muskegon River Wetland contains isolated oil and gas pools, and there are presently several oil wells operating in the middle channel area of the wetland (Great Lakes Basin Commission, 1975); Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Muskegon River Wetland is partially wooded (Michigan Department of State Highways and Transportation aerial photograph, 1976). It was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

The B. C. Cobb Power Plant is located in Muskegon River Wetland. The plant is rated at 510 megawatts, burns coal, and utilizes Muskegon Lake for its supply of condensing water. Consumers Power Company owns the B. C. Cobb plant. Transmission lines from the plant run to the south of and through the Muskegon River Wetland. A sewage disposal facility is situated to the west of the wetland (Federal Power Commission, 1974; Federal Energy Administration, 1977; U.S.G.S. quadrangle maps, Twin Lake, Michigan, 1958; Montague, Michigan, 1959).

Pollution Sources

A sewage disposal facility is situated to the west of Muskegon River Wetland, and the B. C. Cobb Power Plant is located within the wetland. The effect of these facilities (if any) on Muskegon River Wetland was not determined through the literature search. Martz (1976) notes that fly-ash dumping, municipal and industrial fill, petrochemical storage tank leakage, pollution from shipping, agricultural runoff, and potential wastewater from treatment plants may occur within Muskegon River Wetland in the future. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Muskegon River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 110

The literature search identified no on-going or impending research projects pertaining to Muskegon River Wetland.

NORTON SHORES WETLAND

PHYSIOGRAPHIC SETTING

LM 111

Setting

Norton Shores Wetland is located in Muskegon County, Michigan, 0.2 mile southwest of the community of Norton shores. Although it lies 0.8 mile from the Lake Michigan shoreline, Norton Shores Wetland is included in this study because it is contiguous with Mona Lake, which is influenced by the water levels of Lake Michigan. The wetland is a Lacustrine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Norton Shores Wetland is 5 feet; wetland elevations range from 580 to 585 feet above sea level, 0 to 5 feet above the approximate mean elevation of Lake Michigan. The wetland is situated on a lacustrine plain which features flat to gently rolling topography.

Surficial Geology

The surficial geology of Norton Shores Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found throughout the Muskegon area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Norton Shores Wetland is Saranac loam, which consists of a layer of very dark loam underlain with clay loam, silty clay loam, and loamy sand. This soil is very poorly drained and is subject to flooding. Saranac loam has high available moisture capacity and high natural fertility (Pregitzer, 1968).

Hydrology

An unnamed intermittent stream and an unnamed perennial stream flow through Norton Shores Wetland. The wetland is adjacent to Mona Lake (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Norton Shores Wetland.

Climate

The closest weather station providing climatic data for Norton Shores Wetland is located in Muskegon, Michigan. In 1975, the average monthly temperature was 48.4°F, the average daily low for January was 22.4°F and the

average daily high in July was 81.3°F. The average annual precipitation is 31.53 inches, with a mean monthly precipitation of 2.25 inches in January and 2.51 inches in July based on the normal period from 1941-1970. The growing season is approximately seven months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are present in Norton Shores Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 111

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Norton Shores Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Norton Shores Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Norton Shores Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Norton Shores Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Norton Shores Wetland is included in the Muskegon Christmas Bird Count census area. An annotated summary of the 1972-76 counts is presented in Appendix D-8. Since the census area includes sizeable urban, open water, and upland areas, in addition to several other wetlands, care should be exercised in

the interpretation of the relevance of these winter bird counts to Norton Shores Wetland. The most consistently abundant birds observed in the censuses were common mergansers (Mergus merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Norton Shores Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Norton Shores Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 111

Population

Norton Shores Wetland is located in Norton Shores Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 5-9 indicates that the population of Muskegon County was stable between 1970 and 1975, while Norton Shores Township experienced a moderate decline in population during the same time period. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable.

Table 5-9. Population Data for the Vicinity of Norton Shores Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	157,369
Norton Shores Township	21,294	-4.4	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Norton Shores Wetland is urban open space. The surrounding area is heavily developed, with a mixture of residential, commercial, and industrial ownership (Agricultural Stabilization and Conservation Service aerial photograph, 1974). The wetland is under private ownership, within an area estimated to have average growth potential (West Michigan Shoreline Regional Development Commission, 1976).

The immediate presence of residential, commercial, and industrial land use surrounding the wetland may reflect moderate to high development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Norton Shores Wetland.

Mineral, Energy, and Forest Resources

Norton Shores Wetland lies within an area of Silurian salt deposits, but there are no operations in or near the wetland utilizing this resource (Gere, 1977). Although the vicinity of Norton Shores Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Norton Shores Wetland (U.S.G.S. quadrangle map, Muskegon West, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Norton Shores Wetland (Michigan Water Quality Division, 1978). No site-specific information was

located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Norton Shores Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 111

The literature search identified no on-going or impending research projects pertaining to Norton Shores Wetland.

MONA LAKE WETLAND

PHYSIOGRAPHIC SETTING

LM 112

Setting

Mona Lake Wetland is located in Muskegon County, Michigan, adjacent to the community of Norton Shores. Although it lies four miles from the Lake Michigan shoreline, Mona Lake Wetland is included in this study because it is contiguous with Mona Lake, which is influenced by the water levels of Lake Michigan. A portion of the wetland has been filled. Mona Lake Wetland is a non-wooded, Lacustrine System and occupies a low site (U.S.G.S. quadrangle map, Muskegon East, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Topography

The total relief of Mona Lake Wetland is 5 feet; wetland elevations range from 580 to 585 feet above sea level, 0 to 5 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to gently rolling.

Surficial Geology

The surficial geology of Mona Lake Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found throughout the Mona Lake area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Mona Lake Wetland is Houghton muck and peat, which consists of a surface layer of granular black muck underlain with mucky peat and fibrous peat. This organic soil is very poorly drained and has low natural fertility. Houghton muck developed from fibrous marsh grasses, sedges, and reeds (Pregitzer, 1968).

Hydrology

Mona Lake Wetland is adjacent to Mona Lake. An unnamed perennial stream flows into the eastern end of this wetland (U.S.G.S. quadrangle map, Muskegon East, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Mona Lake Wetland.

Climate

The closest weather station providing climatic data for Mona Lake Wetland is located in Grand Haven, Michigan. In 1975, the average monthly temperature was 48.9°F, the average daily low for January was 22.8°F and the average daily

high in July was 78.1°F. The average annual precipitation is 31.28 inches, with a mean monthly precipitation of 2.01 inches in January and 2.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven and one-third months long, with the last killing frost (28°F) in 1975 occurring on April 13 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Mona Lake Wetland (U.S.G.S. quadrangle map, Muskegon East, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974).

BIOTIC SETTING

LM 112

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Mona Lake Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Mona Lake Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Mona Lake Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Mona Lake Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Mona Lake Wetland is included in the Muskegon Christmas Bird Count census area. An annotated summary of the 1972-76 counts is presented in Appendix D-8. Since the census area includes sizeable urban, open water, and upland areas, in addition to several other wetlands, care should be exercised in the

interpretation of the relevance of these winter bird counts to Mona Lake Wetland. The most consistently abundant birds observed in the censuses were common mergansers (Mergus merganser), common goldeneyes (Bucephala albeola), herring gulls (Larus argentatus), and mallards (Anas platyrhynchos).

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Mona Lake Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Mona Lake Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, an NPDES permit holder is located near this wetland and may have some effect on its health.

CULTURAL SETTING

LM 112

Population

Mona Lake Wetland is located adjacent to the City of Norton Shores in Norton Shores Township of Muskegon County, Michigan. The county has a moderate population density of 314 persons per square mile. Table 5-10 indicates that the population of Muskegon County was stable between 1970 and 1975, but Norton Shores Township and the city of Norton Shores experienced a moderate decline in population during the same time period. Projections for 1990 indicate that the population of Muskegon County is expected to remain stable.

Table 5-10. Population Data for the Vicinity of Mona Lake Wetland

	Estimated Population 1975 ^a	Estimated % Δ 1970-1975 ^a	Projected Population 1990 ^b
Muskegon County	156,971	-0.3	157,369
Norton Shores Township	21,294	-4.4	--
City of Norton Shores	21,294	-4.4	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Mona Lake Wetland is urban open space. The surrounding area is in residential and commercial use. Muskegon County Airport is located less than a mile to the south of Mona Lake Wetland. An access road crosses the wetland and a primary highway is situated to the east (U.S.G.S. quadrangle map, Muskegon East, Michigan, 1972; Agricultural Stabilization and Conservation Service aerial photograph, 1974). The wetland lies within an area of small tracts and subdivisions (Rockford Map Publishers, Inc., 1975). The wetland is under undetermined ownership, but its location within an area estimated to have average growth potential (West Michigan Shoreline Regional Development Commission, 1977) suggests that development pressures on the wetland may be high.

Recreation

There are no known state or federal recreational facilities in the vicinity of Mona Lake Wetland.

Mineral, Energy, and Forest Resources

Mona Lake Wetland lies within an area of Silurian salt deposits, but there are no operations in or near the wetland utilizing this resource (Gere, 1977). Although the vicinity of Mona Lake Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (Agricultural Stabilization and Conservation Service aerial photograph, 1974).

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Mona Lake Wetland (U.S.G.S. quadrangle map, Muskegon East, Michigan, 1972).

Pollution Sources

There is one NPDES permit holder adjacent to Mona Lake Wetland. The Brunswick Corporation is located east of the wetland and appears to discharge into Mona Lake (Michigan Water Quality Division, 1978). The extent and effect of this discharge (if any) on Mona Lake Wetland are not known. No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Mona Lake Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 112

The literature search identified no on-going or impending research projects pertaining to Mona Lake Wetland.

LITTLE PIGEON CREEK WETLAND

PHYSIOGRAPHIC SETTING

LM 113

Setting

Little Pigeon Creek Wetland is located 750 feet from the eastern shoreline of Lake Michigan in Ottawa county, Michigan, 4.3 miles north of the community of Port Sheldon. Little Pigeon Creek Wetland is a Lacustrine System and occupies a low, partially wooded site (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Topography

The total relief of Little Pigeon Creek Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain; the surrounding topography is flat to rolling. The Lake Michigan shoreline near Little Pigeon Creek Wetland is described by the Great Lakes Basin Commission (1975) as high sand dunes.

Surficial Geology

The surficial geology of Little Pigeon Creek Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found along much of the Lake Michigan shoreline between Grand Haven and Pigeon Creek (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Little Pigeon Creek Wetland is Adrian-Houghton mucks, which consist of poorly drained, fibrous organic soils with a surface layer of black muck and a subsoil of fibrous peat. This material is underlain with dark gray to light brown loamy sand. Adrian-Houghton mucks have low natural fertility and moderate to very high available water capacity (Pregitzer, 1968).

Hydrology

Little Pigeon Creek Wetland is adjacent to the southern shore of Little Pigeon Creek, and a small stream flows through the wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Little Pigeon Creek Wetland.

Climate

The closest weather station providing climatic data for Little Pigeon Creek Wetland is located in Grand Haven, Michigan. In 1975, the average monthly

temperature was 48.9^oF, the average daily low for January was 22.8^oF and the average daily high in July was 78.1^oF. The average annual precipitation is 31.28 inches, with a mean monthly precipitation of 2.01 inches in January and 2.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven and one-third months long, with the last killing frost (28^oF) in 1975 occurring on April 13 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Little Pigeon Creek Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

BIOTIC SETTING

LM 113

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Little Pigeon Creek Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Little Pigeon Creek Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Little Pigeon Creek Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Little Pigeon Creek Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-8, D-9, and D-10 contain general information on the wetland birds of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Little Pigeon Creek Wetland.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Little Pigeon Creek Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Little Pigeon Creek Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 113

Population

Little Pigeon Creek Wetland is located in Grand Haven Township of Ottawa County, Michigan. The county has a moderate population density of 228 persons per square mile. Table 5-11 indicates that Ottawa County experienced a rapid rate of population growth between 1970 and 1975, while Grand Haven Township experienced a moderate rate of population growth during the same time period. Projections for 1990 indicate that Ottawa County is expected to undergo continued rapid population growth.

Table 5-11. Population Data for the Vicinity of Little Pigeon Creek Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Ottawa County	140,556	9.7	185,342
Grand Haven Township	5,753	4.8	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Little Pigeon Creek Wetland is rural open space. Residential development adjoins the wetland to the west along Lake Michigan; the remainder of the surrounding area is primarily in agricultural and other rural open space uses. A secondary highway crosses the western portion of Little Pigeon Creek Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972; West Michigan Shoreline Regional Development Commission, 1976; U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972). The wetland is under private ownership (Rockford Map Publishers, Inc., 1976), and lies within an area estimated to have much greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977). Its location suggests moderate development pressure.

Recreation

There are no known state or federal recreational facilities in the vicinity of Little Pigeon Creek Wetland.

Mineral, Energy, and Forest Resources

Little Pigeon Creek Wetland lies within an area of Silurian salt deposits, but there are no operations in or near the wetland utilizing this resource (Gere, 1977). Dune and coastal strip sands, such as those near the wetland, are the leading sources of industrial quality sand, due to their pureness and superior physical qualities. However, at present there are no sand extraction operations in or near Little Pigeon Creek Wetland (Michigan Geological Survey, 1975). Gravel resources are also found in the vicinity of the wetland, but no active gravel operations are present (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Although the vicinity of Little Pigeon Creek Wetland contains isolated oil and gas pools, there are presently no drilling operations of this nature near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Little Pigeon Creek Wetland is partially wooded (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

Transmission lines are situated to the south and east of Little Pigeon Creek Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Little Pigeon Creek Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Little Pigeon Creek Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 113

The literature search identified no on-going or impending research projects pertaining to Little Pigeon Creek Wetland.

PIGEON RIVER WETLAND

PHYSIOGRAPHIC SETTING

LM 114

Setting

Pigeon River Wetland is located 1.0 mile from the eastern shoreline of Lake Michigan in Ottawa County, Michigan, 0.3 mile east of the community of Port Sheldon. The wetland occupies the flood plain of the Pigeon River and extends along the river for a distance of approximately three miles. Pigeon River Wetland is a Lower Perennial Riverine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Topography

The total relief of Pigeon River Wetland is 10 feet; wetland elevations range from 580 to 590 feet above sea level, 0 to 10 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain surrounded by rolling terrain.

Surficial Geology

The surficial geology of Pigeon River Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are found throughout the Pigeon River Basin (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Pigeon River Wetland is Adrian-Houghton mucks, which consist of poorly drained, fibrous organic soils with a surface layer of black muck and a subsoil of fibrous peat, underlain with dark gray to light brown loamy sand. Adrian-Houghton mucks have low natural fertility and moderate to very high available water capacity (Pregitzer, 1972).

Hydrology

Pigeon River Wetland is located on both sides of the Pigeon River. The river flows west to Pigeon Lake (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Pigeon River Wetland.

Climate

The closest weather station providing climatic data for Pigeon River Wetland is located in Grand Haven, Michigan. In 1975, the average monthly temperature was 48.9°F, the average daily low for January was 22.8°F and the average daily high in July was 78.1°F. The average annual precipitation is 31.28 inches, with a mean monthly precipitation of 2.01 inches in January and

2.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven and one-third months long, with the last killing frost (28°F) in 1975 occurring on April 13 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Pigeon River Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

BIOTIC SETTING

LM 114

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Pigeon River Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Pigeon River Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Pigeon River Wetland.

Reptiles and Amphibians

Trapping and observation on the Consumers Power Company, J. H. Campbell Plant Unit Number 3 Site during the summer of 1972 yielded a list of amphibians and reptiles which is reproduced in the Table 5-12. The study area included a section of Pigeon River Wetland, in addition to adjacent upland areas. However, the literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Table 5-12. Amphibians and Reptiles Identified on the Campbell Plant Site, Summer 1972^a

American toad	midland painted turtle
Fowler's toad	blue racer
bullfrog	eastern hognose snake
northern leopard frog	northern water snake
wood frog	eastern garter snake

^a Consumers Power Company (1976)

Avifauna

An environmental report on the Consumers Power Company, J. H. Campbell Plant Unit Number 3 includes data on a "river community" which is composed of a segment of Pigeon River Wetland and adjacent upland areas (Consumers Power Company, 1976). This study was based on a limited number of censuses between June 13, 1972 and September 8, 1972. During the study, a total of 45 species of birds were seen in the river community. Included were the red-winged blackbird (Agelaius phoeniceus), great blue heron (Ardea herodias), Eastern kingbird (T. tyrannus), belted kingfisher (Megaceryle alcyon), pectoral sandpiper (Calidris melanotos), spotted sandpiper (Actitis macularia), yellowthroat (Geothlypis trichas), bank swallow (R. riparia), swamp sparrow (Melospiza georgiana) and downy woodpecker (Picoides pubescens). Of these, the red-winged blackbird, Eastern kingbird, and bank swallow were the most common. In comparison to other communities within the Campbell Plant Site, the river community was determined to have the greatest variety of bird species, the highest bird diversity index, and the highest number of uncommon birds.

The important food species found with the wetland areas of the river community were ash, maple, cherry, elderberry, junberry, dogwood, oak, willow, alder, Virginia creeper, poison ivy, grape, blackberry, sedges, pokeweed, and grasses. Cover is excellent within this area and standing dead trees provide excellent nesting habitat for woodpeckers.

The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, or relationship to water levels of the birds utilizing Pigeon River Wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Pigeon River Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Pigeon River Wetland by literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland. However, waste disposal ponds are located near the wetland and may have some effect on its health.

CULTURAL SETTING

LM 114

Population

Pigeon River Wetland is located in Port Sheldon Township of Ottawa County, Michigan. The county has a moderate population density of 228 persons per square mile. Table 5-13 indicates that Ottawa County and Port Sheldon Township experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Ottawa County is expected to undergo continued rapid population growth.

Table 5-13. Population Data for the Vicinity of Pigeon River Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Ottawa County	140,556	9.7	185,342
Port Sheldon Township	1,236	14.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Pigeon River Wetland is rural open space. The surrounding area is characterized by residential development along the southern shore of Pigeon Lake. Rural open space predominates elsewhere, with agricultural uses becoming more important further inland. An area of industrial use (Campbell Power Plant) is located along the Lake Michigan shore to the northwest of the wetland. A rail line and a primary highway are located to the east of Pigeon River Wetland, and access roads lie near the wetland at several points (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972; West Michigan Shoreline Regional

Development Commission, 1976; U.S.G.S. quadrangle map, Port Sheldon, 1972). The wetland is under private ownership (Rockford Map Publishers, Inc., 1976), and lies within an area estimated to have average growth potential (West Michigan Shoreline Regional Development Commission, 1977). Its location suggests moderate development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Pigeon River Wetland.

Mineral, Energy, and Forest Resources

Pigeon River Wetland lies within an area of Silurian salt deposits, but there are no operations in or near the wetland utilizing this resource (Gere, 1977). Although the vicinity of Pigeon River Wetland contains isolated oil and gas pools, there are presently no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey 1977). There are no known coal deposits in the wetland (Smith, 1915), nor are there any significant forest resources (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Public Utilities and Facilities

Waste disposal ponds are situated to the north of Pigeon River Wetland, and several transmission lines run through the wetland. The waste disposal ponds and the transmission lines originate from the Consumer Power Company's J. H. Campbell Power Plant. The Campbell plant, rated at 650 megawatts, burns coal and utilizes Lake Michigan for its source of condensing water (Federal Energy Administration, 1977; Federal Power Commission, 1972; U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Pigeon River Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Pigeon River Wetland, nor are there any known archaeological sites in the vicinity. However, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 114

The literature search identified no on-going or impending research projects pertaining to Pigeon River Wetland.

SLOAN POND WETLAND

PHYSIOGRAPHIC SETTING

LM 115

Setting

Sloan Pond Wetland is located 0.3 mile from the eastern shoreline of Lake Michigan in Ottawa County, Michigan, 0.7 miles south of the community of Port Sheldon. Sloan Pond Wetland occupies a low site and is almost completely wooded. The wetland is a Palustrine and Perennial Riverine System (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Topography

The total relief of Sloan Pond Wetland is 5 feet; wetland elevations range from 595 to 600 feet above sea level, 15 to 20 feet above the approximate mean elevation of Lake Michigan. The wetland lies on a low lacustrine plain, surrounded by rolling terrain. The Lake Michigan shoreline near Sloan Pond Wetland consists of high sand dunes (Great Lakes Basin Commission, 1975).

Surficial Geology

The surficial geology of Sloan Pond Wetland is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are generally found in the area to the east of Sloan Pond (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type in Sloan Pond Wetland is Adrian-Houghton mucks, which consist of poorly drained, fibrous organic soils with a surface layer of black muck and a subsoil of fibrous peat, underlain with dark gray to light brown loamy sand. Adrian-Houghton mucks have low natural fertility and moderate to very high available water capacity (Pregitzer, 1968).

Hydrology

Ten Hagen Creek flows northwest through Sloan Pond Wetland and into Sloan Pond. An unnamed perennial stream flows north from Sloan Pond through the wetland to Pigeon Lake. Sloan Pond is located in the western part of the wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Sloan Pond Wetland.

Climate

The closest weather station providing climatic data for Sloan Pond Wetland is located in Grand Haven, Michigan. In 1975, the average monthly temperature was 48.9°F, the average daily low for January was 22.8°F and the average daily

high in July was 78.1⁰F. The average annual precipitation is 31.28 inches, with a mean monthly precipitation of 2.01 inches in January and 2.77 inches in July based on the normal period from 1941-1970. The growing season is approximately seven and one-third months long, with the last killing frost (28⁰F) in 1975 occurring on April 13 and the first killing frost on November 23 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of Sloan Pond Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

BIOTIC SETTING

LM 115

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Sloan Pond Wetland.

Fish

A search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, life histories, recreational and commercial use, or food sources of the fish populations in Sloan Pond Wetland.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Sloan Pond Wetland.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Sloan Pond Wetland. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland.

Avifauna

Appendices D-8, D-9, and D-10 contain general information on the wetland birds of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Sloan Pond Wetland. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories,

relationship to water levels, or major food sources of the birds utilizing this wetland.

Mammals

The literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting Sloan Pond Wetland.

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in Sloan Pond Wetland by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of this wetland.

CULTURAL SETTING

LM 115

Population

Sloan Pond Wetland is located in Port Sheldon Township of Ottawa County, Michigan. The county has a moderate population density of 228 persons per square mile. Table 5-14 indicates that Ottawa County and Port Sheldon Township experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Ottawa County is expected to undergo continued rapid population growth.

Table 5-14. Population Data for the Vicinity of Sloan Pond Wetland

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Ottawa County	140,556	9.7	185,342
Port Sheldon Township	1,236	14.7	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Sloan Pond Wetland is rural open space. The surrounding area is in rural open space uses, except for shoreline residential development along Lake Michigan (Michigan Department of Natural Resources, 1974). A secondary highway lies adjacent to the western portion of Sloan Pond Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972). The wetland is under private ownership (Rockford Map Publishers, Inc., 1976).

Sloan Pond Wetland lies within an area estimated to have much greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977). However, Sloan Pond and the immediate vicinity has been designated as a "special environmental area" within Michigan's Coastal Zone Management Program. If this plan is realized, the wetland will be likely to face minimal development pressures (West Michigan Shoreline Regional Development Commission, 1977).

Recreation

There are no known state or federal recreational facilities in the vicinity of Sloan Pond Wetland.

Mineral, Energy, and Forest Resources

Dune and coastal strip sands, such as those near Sloan Pond Wetland, are the leading sources of industrial quality sand, owing to their purity and superior physical qualities. At present there are no sand extraction operations in or near Sloan Pond Wetland (Michigan Geological Survey, 1975). Gravel resources are also found in the vicinity, but no active gravel operations are present (Michigan Department of State Highways and Transportation aerial photograph, 1976).

Although the vicinity of Sloan Pond Wetland contains isolated oil and gas pools, there are no drilling operations near the wetland (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits in the wetland (Smith, 1915).

Sloan Pond Wetland is wooded (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972), but it was not determined through the literature search whether this wooded area is subject to commercial timber harvest.

Public Utilities and Facilities

Transmission lines are situated to the east of Sloan Pond Wetland (U.S.G.S. quadrangle map, Port Sheldon, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Sloan Pond Wetland (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Sloan Pond Wetland, nor are there any known archaeological sites in the vicinity, however, the area has not been systematically surveyed by a professional archaeologist (Peebles and Black, 1976).

RESEARCH PROJECTS

LM 115

The literature search identified no on-going or impending research projects pertaining to Sloan Pond Wetland.

BIG BAY WETLAND COMPLEX

PHYSIOGRAPHIC SETTING

LM 116-118

Setting

The Big Bay Wetland Complex, comprised of Big Bay Wetlands #1-#3, is located in Ottawa County, Michigan. Although these wetlands lie more than 1,000 feet from the Lake Michigan shoreline, they are included in this study because they are closely associated with Lake Macatawa, which is influenced by the water levels of Lake Michigan. Big Bay Wetland #1 lies one mile north of the community of Virginia Park and one mile from the Lake Michigan shoreline. The wetland is a low, wooded, Palustrine System. Big Bay Wetland #2 is located 1.3 miles north of Virginia Park and 0.8 mile from the Lake Michigan shoreline. It is a Palustrine System and occupies a low, wooded site. Big Bay Wetland #3 is contiguous with Lake Macatawa; it lies 1.3 miles north of Virginia Park and 1.1 mile from Lake Michigan. Big Bay Wetland #3 is a Lower Perennial Riverine and Lacustrine System and occupies a low, non-wooded site (U.S.G.S. quadrangle map, Holland West, Michigan, 1972).

Topography

The total relief of Big Bay Wetlands #1 and #2 is 5 feet; elevations of the wetlands range from 585 to 590 feet above sea level, 5 to 10 feet above the approximate mean elevation of Lake Michigan. The total relief of Big Bay Wetland #3 is also 5 feet at elevations from 580 to 585 feet above sea level. Big Bay Wetlands #1-#3 lie on a lacustrine plain, surrounded by rolling terrain.

Surficial Geology

The surficial geology of Big Bay Wetlands #1-#3 is characterized by lake beds comprised mainly of sand. These glaciolacustrine sediments consist of fine-grained products of glacial erosion and are generally found in the Lake Macatawa area (Martin, 1957; Dorr and Eschman, 1970).

Soils

The soil type for Big Bay Wetlands #1-#3 is Marsh, which is wet throughout the year and consists of peat. The vegetation supported by Marsh soil includes cattails, sedges, water weeds, and water tolerant trees (Pregitzer, 1968).

Hydrology

An unnamed perennial stream flows south through Big Bay Wetland #3 into Lake Macatawa. An unnamed intermittent stream, a tributary of the perennial stream, flows west through the wetland. Big Bay Wetland #3 is adjacent to Big Bay of Lake Macatawa. No streams flow through Big Bay Wetlands #1 and #2

(U.S.G.S. quadrangle map, Holland West, Michigan, 1972). The literature search provided no site-specific data pertaining to water level influences, groundwater drainage patterns and runoff, water quality, depth, or seasonal changes in Big Bay Wetlands #1-#3.

Climate

The closest weather station providing climatic data for Big Bay Wetland is located in Holland, Michigan. In 1975, the average monthly temperature was 49.5°F, the average daily low for January was 23.2°F and the average daily high in July was 84.6°F. The average annual precipitation is 35.01 inches, with a mean monthly precipitation of 2.30 inches in January and 3.25 inches in July based on the normal period from 1941-1970. The growing season is approximately six and a quarter months long, with the last killing frost (28°F) in 1975 occurring on April 21 and the first killing frost on October 30 (National Oceanic and Atmospheric Administration, 1975).

Special Features

No natural special features are found in the vicinity of the Big Bay Wetland Complex (U.S.G.S. quadrangle map, Holland West, Michigan, 1972).

BIOTIC SETTING

LM 116-118

Vegetation

The literature search yielded no site-specific information pertaining to major species composition and distribution, density and productivity, or relationship to water levels of the vegetation of Big Bay Wetlands #1-#3.

Fish

Lake Macatawa contains the following game fish species: smallmouth bass (Micropterus dolomieu), largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), pumpkinseed (Lepomis gibbosus), rock bass (Ambloplites rupestris), crappie (Pomoxis sp.), yellow perch (Perca flavescens), walleye (Stizostedion vitreum), bullhead (Ictalurus spp.), channel catfish (Ictalurus punctatus), northern pike (Esox lucius), and white bass (Morone chrysops). Some of these species may occur in Big Bay Wetlands #1, #2, and #3. All these species provide a recreational fishery in Lake Macatawa. Carp (Cyprinus carpio) were historically abundant and were commercially harvested by seines (Lieuwense, 1946). Since Lake Macatawa is an important recreational unit, more recent data pertaining to its fish fauna (and possibly to Big Bay Wetlands #1, #2, and #3) may exist in unpublished files of the Michigan Department of Natural Resources. However, a search of the literature provided no site-specific information pertaining to major species, species composition, spawning and hatching areas, seasonal locations and abundance, recreational and commercial use, or food sources of the fish populations in Big Bay Wetlands #1-#3.

Invertebrates

The literature search produced no site-specific data pertaining to species composition, seasonal distribution and abundance, density and productivity, food sources, or relationship to water levels of the invertebrates present in Big Bay Wetlands #1-#3.

Reptiles and Amphibians

Appendix C-6 contains general information on the amphibians and reptiles of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Big Bay Wetlands #1-#3. The literature search yielded no site-specific information pertaining to major species, seasonal distribution and abundance, density, recreational and commercial use, life histories, major food sources, or relationship to water levels of the reptiles and amphibians in this wetland complex.

Avifauna

Appendix D-8, D-9, D-10 contain general information on the wetland birds of Lake Section 5, but care should be exercised in the interpretation of the relevance of this information to Big Bay Wetlands #1-#3. The literature search provided no site-specific information pertaining to seasonal abundance, density and productivity, recreational and commercial use, health, life histories, relationship to water levels, or major food sources of the birds utilizing these wetlands.

Mammals

Mammalian species which may utilize the three wetlands comprising the Big Bay Wetland Complex are listed in Table 5-15. However, the literature search provided no site-specific data pertaining to major species, seasonal distribution and abundance, density and productivity, recreational and commercial use, life histories, food sources, or relationship to water levels of the mammals inhabiting these wetlands.

Table 5-15. Mammalian Species of the Macatawa River Basin^a

<u>Common Name</u>	<u>Common name</u>
masked shrew	muskrat
short-tailed shrew	red fox
star-nosed mole	raccoon
white-footed mouse	long-tailed weasel

^a Brewer, 1976

Endangered Species

No plants or animals appearing on the federal or state lists of endangered or threatened species (U.S. Fish and Wildlife Service, 1977; Michigan Endangered and Threatened Species Program, 1976) were documented in the Big Bay Wetland Complex by the literature search.

Health

The available information is not sufficient to allow an evaluation of the environmental quality of these wetlands.

CULTURAL SETTING

LM 116

Population

Big Bay Wetlands #1-#3 are located in Park Township of Ottawa County, Michigan. The county has a moderate population density of 228 persons per square mile. Table 5-16 indicates that Ottawa County and Park Township experienced a rapid rate of population growth between 1970 and 1975. Projections for 1990 indicate that Ottawa County is expected to undergo continued rapid population growth.

Table 5-16. Population Data for the Vicinity of Big Bay Wetlands #1-#3

	Estimated Population 1975 ^a	Estimated %Δ 1970-1975 ^a	Projected Population 1990 ^b
Ottawa County	140,556	9.7	185,342
Park Township	8,375	26.1	--

^a U.S. Bureau of the Census (1977)

^b Michigan Department of Management and Budget (1977)

Land Use and Ownership

Land use within Big Bay Wetlands #1-#3 is rural open space. The surrounding area is characterized by residential development along most of the Lake Macatawa shoreline, with occasional subdivisions inland. Access roads and a secondary highway are located near all of the wetlands in the Big Bay Wetland Complex. The highway crosses through Big Bay Wetlands #1 and #3. A public access site to Lake Macatawa is located near all three wetlands, and groins extend into the lake close by (U.S.G.S. quadrangle map, Holland West, Michigan, 1972; West Michigan Shoreline Regional Development Commission, 1976; U.S.G.S. quadrangle map, Holland West, Michigan, 1972). The wetlands are under private ownership (West Michigan Shoreline Regional Development Commission, 1976), and

lie within an area estimated to have much greater than average growth potential (West Michigan Shoreline Regional Development Commission, 1977). The immediate presence of extensive residential land use surrounding the wetlands, coupled with private ownership, reflect moderate to high development pressures.

Recreation

There are no known state or federal recreational facilities in the vicinity of Big Bay Wetlands #1-#3.

Mineral, Energy, and Forest Resources

There are no active sand or gravel operations in or near Big Bay Wetlands #1-#3 (Michigan Geological Survey, 1975). Although the vicinity of the wetlands contains isolated oil and gas pools, there are presently no drilling operations near the wetlands (Great Lakes Basin Commission, 1975; Michigan Geological Survey, 1977). There are no known coal deposits within the wetland complex (Smith, 1915).

Big Bay Wetlands #1 and #2 are wooded (U.S.G.S. quadrangle map, Holland West, Michigan, 1972), but it was not determined through the literature search whether these wooded areas are subject to commercial timber harvest. There are no significant forest resources in Big Bay Wetland #3.

Public Utilities and Facilities

There are no public utilities within 0.5 mile of Big Bay Wetlands #1-#3 (U.S.G.S. quadrangle map, Holland West, Michigan, 1972).

Pollution Sources

There are no NPDES permit holders adjacent to Big Bay Wetlands #1-#3 (Michigan Water Quality Division, 1978). No site-specific information was located through the literature search pertaining to non-point sources of pollution.

Historical and Archaeological Features

No known historical sites exist within 500 feet of Big Bay Wetlands #1-#3 (Peebles and Black, 1976). An environmental assessment of the Kalamazoo, Black, Macatawa, and Paw Paw River basins indicates that Big Bay Wetlands #1-#3 are located in an area that is archaeologically "sensitive." Although no specific sites are known in this area, a thorough archaeological survey should be conducted before the wetlands are subjected to any development that might destroy or disturb possible sites (Western Michigan University, 1976).

RESEARCH PROJECTS

LM 116-118

The literature search identified no on-going or impending research projects pertaining to Big Bay Wetlands #1-#3.

Table 5-17. Data Gaps - Lake Section 5

Data Gap*		Wetland Number		107	108	109	110	111	112	113	114	115	116-118	
Physiographic Setting	Setting													
	Topography													
	Surficial Geology													
	Soils													
	Hydrology	Water Level Fluctuations	*	*	*	*	*	*	*	*	*	*	*	*
		Ground-water	*	*	*	*	*	*	*	*	*	*	*	*
		Water Quality	*	*	*	*	*	*	*	*	*	*	*	*
		Depth	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Changes	*	*	*	*	*	*	*	*	*	*	*	*
	Climate													
Special Features														
Biologic Setting	Vegetation	Major Species Distribution	*	*	*	*	*	*	*	*	*	*	*	
		Major Species Composition	*	*	*	*	*	*	*	*	*	*	*	
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	
		Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	
	Fish	Major species	*	*	*	*	*	*	*	*	*	*	*	*
		Species Composition					*	*	*	*	*	*	*	*
		Seasonal Distribution					*	*	*	*	*	*	*	*
		Spawning and Hatching Areas					*	*	*	*	*	*	*	*
		Commercial/Recreational Use					*	*	*	*	*	*	*	*
		Life Histories	*	*	*	*	*	*	*	*	*	*	*	*
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*
	Invertebrates	Species Composition	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*
		Food Sources	*	*	*	*	*	*	*	*	*	*	*	*
	Amphibians/Reptiles	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*
		Major Species	*	*	*	*	*	*	*	*	*	*	*	*
		Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*
		Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*
		Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*
Life Histories		*	*	*	*	*	*	*	*	*	*	*	*	
Avifauna	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Major Species	*	*	*	*	*	*	*	*	*	*	*	*	
	Seasonal Distribution	*	*	*	*	*	*	*	*	*	*	*	*	
	Density/Productivity	*	*	*	*	*	*	*	*	*	*	*	*	
	Recreational/Commercial Use	*	*	*	*	*	*	*	*	*	*	*	*	
	Life Histories	*	*	*	*	*	*	*	*	*	*	*	*	
	Food Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Relationship to Water Levels	*	*	*	*	*	*	*	*	*	*	*	*	
	Mammals	Major Species	*	*	*	*	*	*	*	*	*	*	*	*
Seasonal Distribution		*	*	*	*	*	*	*	*	*	*	*	*	
Density/Productivity		*	*	*	*	*	*	*	*	*	*	*	*	
Recreational/Commercial Use		*	*	*	*	*	*	*	*	*	*	*	*	
Life Histories		*	*	*	*	*	*	*	*	*	*	*	*	
Food Sources		*	*	*	*	*	*	*	*	*	*	*	*	
Relationship to Water Levels		*	*	*	*	*	*	*	*	*	*	*	*	
Cultural Setting	Endangered Species													
	Health	*	*	*	*	*	*	*	*	*	*	*	*	
	Population													
	Land Use and Ownership													
	Recreation													
	Mineral, Energy, Forest Resource													
	Public Utilities/Facilities													
	Point Pollution Sources													
	Non-Point Pollution Sources	*	*	*	*	*	*	*	*	*	*	*	*	
	Historic Features													
Archaeologic Features	*	*	*	*	*	*	*	*	*	*	*	*		

