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THE EFFECTS OF POLLUTION ON
THE RECREATIONAL USES OF WATER

Thesis for the Degree of M. S.
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ABSTRACT

THE EFFECTS OF POLLUTION ON THE RECREATIONAL USES OF WATER

by Paul D. Adams

The demand for the recreational uses of water increases as the population grows and standard of living improves. Industries and cities expand; recreational uses intensify; water pollution and associated problems spread across the state.

Instances of reduced or destroyed recreational and esthetic values in the State of Michigan were discovered through interviews with state, county and city employees, Michigan State University faculty members, businessmen, land owners and others; published and unpublished reports from state agencies and the City of Lansing; and in the usual published matter. Several lakes and streams were surveyed to examine pollution and determine public reaction to it. Grand River in the Lansing area and Barton Lake, Kalamazoo County were studied to determine the economic effects of pollution on the local economics.

The destruction of fish and wildlife habitat often occurs as owners rake stream beds and prune the banks bringing the wilderness under control, and beauty along Lake Michigan's dynamic shoreline is lost in futile attempts to stabilize this shifting, moving landscape.

Litter is a problem throughout the state but is especially acute along the canoe trails and urban river banks. All too often the city, village, or township dump is located on the river's bank or floodplain, or in the marshland of some lake.

Overdevelopment in the more populated areas, where cottages are placed row on row about the circumference of the lake, overwhelms the recreational facilities and saturates the soil with the effluent from hundreds of septic tanks which fertilizes the lake and produces explosive growths of weeds and algae.

The waste problems of industry and municipalities increase in proportion to the growth of factories and cities. The threat here is not only to the waters but to the thinking and value judgments of people who seem to grow more accustomed and tolerant of polluted water as time passes.

Public reaction to pollution or the misuse of water is unpredictable and is an unsound basis for water policy.

People are too frequently unaware of pollution and often unconcerned through lack of knowledge or esthetic

Paul D. Adams

judgments. The major difficulty in pollution control is in the attitudes of the people, too few of whom care about the conditions in the water. The lack of esthetic judgment apparent with respect to water pollution also occurs in many other aspects of society.

The solution to the problem is in part, presenting facts and explanations of facts to the public through the mass media of communication. A reinterpretation of existing laws shifting the emphasis from absolute private rights of ownership toward certain public rights and interests would clarify the responsibility of owners to the public. Esthetic judgment and respect for nature can be generated, only by the efforts of many persons in a variety of endeavors, all concerned with these values.

**THE EFFECTS OF POLLUTION
ON THE RECREATIONAL USES OF WATER**

by

Paul Delmer Adams

A THESIS

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INTRODUCTION

The domestic needs for water, once satisfied from the old oaken bucket, have increased to the point where, collectively, they threaten to drain the largest reservoirs. The problem is basically a growing population and its increasing standard of living boasting of homes with two baths, two cars to wash, automatic gadgetry, and often an acre or so of lawn watered regularly, each adding to the demand on the water resources.

Industry, keeping pace with the population growth and providing the high standard of living, also makes a greater demand on available water.

Wealth and leisure time, part of the higher standard of living, provide a means for people to satisfy the desire for outdoor recreation which is usually associated with water and which again adds to the demand.

According to the Outdoor Recreational Resources Review Commission (ORRRC) the average work week has shrunk from sixty hours in 1900 to forty hours today; it is expected to shrink still further until, by the year 2000, it will be thirty-two hours. During this same period the national disposable income will grow from 350 billion to 1,437 billion dollars.¹

¹Outdoor Recreation Resources Review Commission, Outdoor Recreation For America, A Report to the President and Congress by the Outdoor Recreation Resources Review Commission, (Washington, D.C.: U.S. Government Printing Office, 1962), p.30.

The ORRRC report states that in 1960 there were 672 million occasions when persons 12 years old or older went swimming and predicts that by 1976 the number will increase to 1,182 million and by 2000 to 2,307 million occasions. Fishing, boating, water skiing, and other recreational uses of water are expected to develop in a similar manner.²

The increasing pressures on water supplies are manifested most clearly in the problems of pollution. Municipal and industrial waste disposal in rivers and streams is an accepted practice and the rapidly expanding cities and industries across the nation have increased this burden, often beyond the capacity of the waters to carry.

The ORRRC predicts that by 2000 A.D. seventy-three percent of the United States population will be in urban centers. The daily volume of wastes produced by these 255 million people and the massive daily loads dumped by industry will be far beyond the capacities of the already overtaxed water system.³

Water pollution must also be examined in the light of the growing demand for recreational uses. New highways and better travel have put the majority of the population within easy reach of all our lakes and streams. Some streams which were subjected to only moderate usage in the past

²Ibid.

³Ibid.

because of their distance from urban centers are beginning to show the effects of intensive use. Local waters, already overdeveloped, are threatened with extinction as expanding cities engulf the areas and seasonal dwellings become low-cost permanent housing. Rivers and river banks, once ignored by everyone except those with refuse to dispose of, are being reclaimed by home owners in an effort to escape city living.

This study was made in an attempt to determine the effects of various forms of pollution on the recreational values of water and to expand the traditional definition of pollution to include changes in lakes and streams that restrict these recreational uses. It proceeded from the position that as the ecology and purity of the water were altered, recreational uses would change correspondingly and that the loss of these values would be reflected in the economy of the area.

Instances of diminished or destroyed recreational values were discovered in interviews with state, county and municipal employees members of the Michigan State University faculty, businessmen, landowners and others; instances were also found in searching the records and other unpublished materials of state agencies and the City of Lansing. The usual published materials were also used.

Several lakes, streams and rivers were surveyed to examine pollution and determine the public's reaction to it.

The Grand River in the Lansing area and Barton Lake, Kalamazoo County, were studied to determine the economic effects of pollution.

Two factors were revealed very early in the study: first, that the demand for recreational water is so great, particularly in the large urban areas, that mass activity obscures most public reaction to undesirable conditions that may exist; and secondly, that too many users have no understanding of ecological phenomenon and no appreciation for esthetic values of the water.

It became apparent that almost any change can be made in a lake, stream or river without noticeable reaction from the public.

I. POLLUTION NEEDS A DEFINITION

Every person has his own view of pollution. His understanding of the problem and the uses he makes of water are reflected in his definition.

Most people rely on others for clean water and on the dictionary for a definition. Pollution, as Webster says, is "to make unclean or to defile" which the public understands as a threat to the public health or to wildlife. The less obvious aspects of the situation are overlooked and unless there is a nuisance involved, people are generally unconcerned.

The law in Michigan is found in Public Act 245, 1929 as amended by Public Act 117, 1949. Section 6 of this act states: "It shall be unlawful for any person to discharge or permit to be discharged into any of the lakes, rivers, streams or other bodies of water of this State any substance which is injurious to the public health or to the conducting of any industrial enterprise or other lawful occupation; or whereby any fish or migratory bird life or any wild animal or aquatic life may be destroyed or impaired as the consequence of said pollution."

The law provides the necessary mechanisms for the protection of the water resources in the State. However, its application has been unsatisfactory due to the lack of precise definitions of use, pollution and various hydrological

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terms. The difficulty with any law has always been to apply general regulations to a specific circumstance; the interpretation of this law, based on the reasonable use doctrine, is no exception. The doctrine allows any use of water by a riparian owner so long as other owners are not unduly effected. It is, in effect, an attempt to interpret an individuals right to water in the light of the rights of all other owners. Again the problem is definition. What is reasonable use? Each instance is judged separately according to the facts in the case.

The doctrine, as it functions, leaves the definition of pollution to the users. That is, excepting circumstances clearly defined by laws, the condition of the water is deemed not polluted if anyone makes use of it and as long as no one complains.

The Grand River has been declared uppolluted by the Michigan Water Resources Commission when, in fact, the river is choked with weeds above Lansing, littered with debris through Lansing and taxed to capacity by the Lansing sewage disposal plant. Until recently few people had given the river much thought and this unlovely condition was considered normal.

II. THE EFFECTS OF POLLUTION ON THE RECREATIONAL AND ESTHETIC VALUES OF WATER

When pollution is defined in terms of subsequent uses the determination depends on the understanding of the users and there are many levels of understanding. Some are able to see and enjoy the tenuous associations across the farthest reaches of the habitat while others barely see beneath the surface of the water.

Pollution--the destruction of any of the values of water--occurs too frequently without public awareness.

The popularity of northern stream banks as cottage sites grows each year until the natural ecology of the areas through which the streams flow and the streams themselves are threatened with extermination. Wildness is subdued, banks are pruned and stream beds are raked and cleaned until any resemblance to the original setting is lost in the uncertain memory of the proud owner.

Damage occurs in small areas and in subtle ways which are not noticeable to the casual observer. A log is removed, a rock is pulled out or a bank broken down and little by little the stream's habitat is altered, with each alteration affecting the capacity of the stream to produce trout which presumably the cottage owners desire. The Fish Division of the Michigan Conservation Department fights an

endless battle protecting trout streams from lovers of the great outdoors.

Marshlands are an important segment of recreational waters in the State. From a purely practical point of view marshlands provide much pleasure from the pursuit of waterfowl, game fish and fur-bearing animals which they produce and in addition have some of the most interesting plant associations of the state.

These values are missed by the majority who know little about spawning grounds and nesting sites and care nothing about plant associations. The marshlands along the



Meridian Township Dump
Lake Lansing

Fig. 1

margins of lakes are frequently destroyed as they were in Lake Lansing by the Meridian Township dump (Fig.I). In Houghton Lake the marshes were filled to provide land for subdivision into resort properties.

Few people connect expanding weed beds and spreading algae with the number of

cottages surrounding a lake. Owners become aware of the problem when weeds have filled the bays and shallow water and begin the encroachment into open water. Too late the owners learn that waters respond to fertilizer as do soils; that neither harvest of weeds nor application of herbicide can control a situation maintained by hundreds of working septic tanks producing a constant supply of nutrients.

Lake Lansing, Ingham County, has been ringed with cottages for many years. As East Lansing and Haslett expanded under the pressure of a growing population the areas to the west and southwest of the lake were subdivided for medium and low cost housing. Each house and cottage is



Weed Beds Lake Lansing

Fig.2

serviced by a septic tank producing a flow of nutrient material to feed the extensive weed beds (Fig. 2).

The owners have organized to halt the destruction of the lake and to promote its rejuvenation. The community will be connected to the East Lansing sewer system in the

near future and fertilization of the lake should be reduced thereby.

Many persons using lakes and streams apparently lack an appreciation of the esthetic values and are on the water to escape the city or a job, or possibly only for the exercise. Michigan canoe trails are rapidly becoming ribbons of litter winding across the state. Fishermen and streamside owners complain more and more about the debris that is discarded indiscriminately by canoeists. The problem is not confined to canoe trails however. The most discouraging aspect of pollution is the evidence of this thoughtlessness that litters every river bank and fills the waters with oil drums, tires, broken concrete, cans, bottles, etc., etc., etc. (Figures 3, 4, 5).

Natural beauty is often destroyed along the Great Lakes as owners make a desperate attempt to maintain their grasp on these dynamic shores.⁴ Cottages are constructed on the eroding banks and shifting beaches and every conceivable method is used to protect this property. Although the efforts to stabilize the sand are usually unsuccessful and expensive, the groins, seawalls, jettys and other structures grow in size and number (Figures 6, 7, 8, 9, 10).

⁴C. H. Humphreys, Great Lakes Shoreline Survey,
(East Lansing, Mich., Michigan State Press,)

It is impossible to cage a landscape moving and changing under the influence of winds and waves but the demand for resort real estate is very great and the lessons to be learned from already developed beaches are easily forgotten under the spell of a virgin stretch.

During the summer of 1958 a development project was begun on the White River, Sec. 3, T13N, R15W, Oceana County. The land was leveled by bulldozer, hollows were filled and, in the process, the stream bank was broken down and considerable earth pushed into the water producing severe siltation. The raw bank was left without protection against future erosion and the inevitable siltation.⁵

The Fish Division discovered the situation and the owners were required to restore the banks to as near normal conditions as possible.⁶

Similarly, on the main stream of the AuSable, Sec.9 T26N, R3W, Crawford County, the Beaver Island Subdivision obtained its needed fill from the river.⁷ Beaver Island originally was separated from the mainland by a low area

⁵Letter from R.G. Wicklund, Technical Stream Supervisor, Fish Division, Michigan Conservation Commission. Feb. 1963.

⁶Letter from L.N. Jones, Deputy Director, Field Operations, Michigan Conservation Department to Fritz Finkler, Land Owner, August 4, 1959.

⁷Letter from D.S. Shetter, Manager, Hunt Creek Trout Research Station, Fish Division, Michigan Conservation Commission, Dec.12, 1960.



Fig. 3

Debris on the Banks of
the Grand River
Lansing

Fig. 4

Debris on the Banks of
the Red Cedar
Williamston Area



Fig. 5

City Dump
Grand River, Lansing



Fig. 6

Abandoned Beach
Structures
Oceana County

Fig. 7

Beach Structures
Damaged by
Wind and Rain
Berrien County



Fig. 8

Debris on Beach
Berrien County



filled with brush and having very little water in it. The dredging operation deepened this shallow bed until it carried forty percent of the main flow. This new channel, about 1700 yards long, varied in depth from five to seven feet with banks so steep that wading was hazardous if not impossible. The habitat was drastically changed by the removal of the natural litter and bottom sands and gravels. The invertebrate and insect populations were destroyed.

A riverine lake was created in the main channel where the sluggish flow permitted an increase in aquatic plants and favored the production of minnows, northern pike, rock bass and other fish.

The Fish Division again forced the owner to correct as much of the damage as possible.⁸ Wading was restored, protection provided against erosion, trout cover replaced along the banks and the flow of water was restored in the main channel.

This type of pollution progresses slowly throughout a lake or stream and people become accustomed to it--a few tin cans, an eroding stream bank, a bit of destroyed habitat--little by little we are prepared for total destruction. This acquired tolerance is retained as the individual moves from one body of water to another. People who live near the

⁸R.G. Wicklund, Technical Stream Supervisor, Fish Division, Michigan Conservation Commission, Letter, Dec. 9, 1960.

Grand River, for instance, will probably not notice as quickly the cans encountered on a trip down the AuSable.

Demands for Water Hide the Effects of Pollution

The number of people using Michigan's water resources for recreational purposes is so great that the restraining effects of pollution are difficult to determine.

Until 1961 the sanitary facilities at the Higgins Lake State Park included a septic tank and the usual drain fields, in this case layed out beneath the camping areas.⁹ The park is a popular camp ground enjoyed by large numbers of people and during periods of peak attendance the flow of effluent from the systems was greater than the soil could accomodate. It saturated the ground over the drain fields and frequently came to the surface. Park officials seemed the only ones greatly concerned about the unhealthy situation and attempted to improve conditions by ditching around tents so that some of the sewage would drain away. Drainage, of course, was to the lake where campers swam.

Attendance records indicate that these conditions had little effect on the number of persons using the park. The 1959 attendance was 200,245 and in 1960, 189,500.¹⁰

⁹Direct communication, Sanitary Engineer Parks Division, Michigan State Conservation, May 1963.

¹⁰Official Statement, State of Michigan Conservation Commission, State Park Revenue Bonds, September 10, 1963.

By the 1961 season sewage lagoons had been constructed and the number of camp sites reduced so that sanitary facilities were adequate. Again the records show that the park was used to capacity. In 1961 the attendance was 179,780 and in 1962 it was 200,135.¹¹

For the past twenty years the State Health Department has watched, tested, and been concerned about the water conditions in Lake Erie at Sterling State Park. Winds off the Lake blow wastes from the Detroit River and the River Raisin and several drains in the vicinity of the park into the swimming areas and bacteria counts climb until they exceed the accepted levels. The condition of the water varies from day to day and is so unpredictable that the State Health Department, considering the situation hazardous, closed the beaches to swimming in 1961, 1962, and 1963.

In 1960 attendance at Sterling was 911,246 persons and the following year, when the beach was closed to swimming, it dropped to 651,726 persons, many of whom continued to swim in spite of warning signs. In 1962, the second season during which the beach was closed, attendance fell to 255,314,¹² Again, many people used the beaches without regard for the condition of the water.

¹¹Ibid.

¹²This drastic reduction was influenced to an unknown extent by the fact that roads leading into the park and parking lots had been torn up in the process of improving them.

North, on the shores of Lake St. Clair, a similar¹³ situation exists where wastes pouring into the lake from the Clinton River and storm sewers of St. Clair Shores are periodically driven in to the swimming areas by onshore winds forcing the bacteria counts above the accepted standard.¹⁴

The commercially operated St. Clair Beach was closed during the summer of 1963 on June 11, July 23 and August 16. Each closing was due as much to the unsanitary conditions in the bathhouse and toilets as to the bacterial counts in the water. Mr. Melvin Damond, Sanitary Engineer for Macomb County Health Department, stated that the department received many phone calls complaining about the closure, and also stated that warning signs could not be posted over the water because swimmers used them for diving platforms.¹⁵

The Clinton River in the State Recreation Area at Utica has never been approved for swimming by the Macomb County Health Department and has been posted continuously. People still swim in this water carrying raw sewage from Rochester and other cities upstream.¹⁶

¹³Interview with Melvin Damond, Sanitary Engineer, Macomb County Health Department, October, 1963.

¹⁴Accepted standard is 2400 most probable number per 100 milliliter. Three consecutive readings in excess of this is considered hazardous by the Macomb County Health Department.

¹⁵Damond, loc. cit.

¹⁶Ibid.

It is difficult to understand this disregard for an obvious health hazard. There are no doubt many reasons, partly ignorance and partly lack of concern, but the point remains that many people will not or can not distinguish between polluted and unpolluted waters.

III. NO APPARENT ECONOMIC EFFECTS

When pollution is defined by the subsequent uses of water the problem of comparing one use with another arises, as, for instance, when the merits of water skiing are compared with those of waste disposal. The obvious approach is to reduce both uses to the common denominator--money--before comparing. This procedure is, at best, a difficult one since the esthetic and recreational values are intangible and not easily reduced to dollar amounts.

The intangible values reflected in the demand for waters are not salable as such. There are no primary values involved¹⁷ and therefore the water values must be computed in terms of value added through purchase¹⁸ and, to some extent, secondary values.¹⁹

Values added through purchases and secondary values are never clearly defined and may be gathered to the point of absurdity, or may as easily be pared to the barest minimum. No two authors, it appears, ever agree on the extent of these values.

¹⁷Primary Values: The amount by which the market value of the product exceeds the value of the goods and services obtained to produce it.

¹⁸Values Added by Purchases: Values added to water through purchases made in using the water, i.e. fishing equipment, lodging, boats.

¹⁹Secondary Values Added: Value added to water through purchases made by concessionaires, livery men, resort owners.

Adding to the confusion is the fact that recreational resources are furnished to the people at minimal costs which do not reflect true market values and are therefore always under valued, often as much as fifty percent.²⁰

If pollution has an effect on the economy of an area it should be most evident in riparian land values which are tangible and easily determined.

The Grand River passes through Lansing in various stages of pollution.

Beginning at the South Waverly Road bridge, the river makes a seven-mile loop through the city. In the middle of the southwestern residential section is an impoundment to accumulate cooling waters for the Moore's Park power plant. Somewhat east and downstream from the dam it turns north and is joined by the Red Cedar River. The enlarged stream then flows north through the business district into a second impoundment created by a dam at Grand River Avenue and furnishing cooling waters for another power plant. The river then flows westerly through a residential area to the northwest edge of the city.

The thirty-one year average flow in the Lansing area is 851 cubic feet per second (CFS) with the highest momentary maximum of 24,500 cfs recorded for May 26, 1904 and a least

²⁰ Nathaniel Wollman, The Value of Water in Alternative Uses, (University of New Mexico Press, Albuquerque, New Mexico.

minimum of 20 cfs on January 2, 1941.

The river, as it enters Lansing, is not what the State Water Resources Commission calls polluted and, in terms of industrial requirements the water is neither good nor bad.²¹ A chemical analysis²² of the water at the South Waverly Road bridge reveals that the color²³--ranging from fifty to seventy parts per million (ppm)--is high for most industrial uses and that turbidity, low during the winter months but increasing to a high of fifteen ppm in midsummer, would require processing for use in food industries' high pressure boilers, brewing or the production of fine papers.

Total solids are comparatively low ranging from 348 to 420 ppm, and would be acceptable to most industries with the exception of the high pressure boilers, fine papers, clear plastics and the like.

The water is normally slightly alkaline, varying from a pH of 7.6 to 8.3, and acceptable to a variety of uses, but it is very hard (265 to 315 ppm of CaCO_3) and requires softening.

²¹David K. Todd, Ground Water Hydrology, (London, John Wiley & Sons, Inc., November, 1962), pp. 186-187.

²²Water Resources Conditions and Uses in the Upper Grand River Basin, (Lansing, Michigan, Michigan Water Resources Commission, 1961), p. 86.

²³Todd, op. cit. p. 183, Color in parts per million as measured against standard solutions.

Bacterial counts²⁴ vary considerably depending on the rainfall and storms. The County Health Department considers the river above Moore's Park dam to be "reasonably safe" but recognizes the dangers from storm sewers in the Waverly Park subdivision which are equipped with diversion valves to transfer the flow from the sewage system into the storm sewers at times of maximum flow. The County Health Department reports that these valves have stuck open at times, continuing to dump sewage into the river long after the high flow has passed.

Oxygen is the prime element in the decomposition and ultimate purification of sewage as well as other organic wastes dumped into the waters. The organic materials are decomposed and in time consumed by the lower organisms and and oxidized to produce carbon dioxide, various nitrates and other compounds of oxygen.

The desirable species of aquatic animal life require from three to five parts per million of dissolved oxygen and the ability of a body of water to sustain life or handle more sewage is quickly estimated on this basis.

The amount of dissolved oxygen in the Grand River varies considerably as is demonstrated by periodic analysis by the Board of Water and Light. In August of 1963 the oxygen content varied at the Logan Street bridge from 1.9 ppm

²⁴Interview with Sanitary Engineer, Ingham County Health Department, October, 1963.

at 83.3 degrees Farenheit to 8.05 ppm at 77 degrees.²⁵

Lansing's Uses of the Grand River

The three uses which Lansing makes of the Grand River are sewage disposal which, in view of current trends, can only increase; a source of cooling waters which will very shortly be discontinued; and recreational uses which will undoubtedly grow as long as there is room available and new pleasures to be found.

The sewage disposal plant is a 3.5 million dollar²⁶ investment which processes the wastes and garbage of 120,000 people--a volume of about 18.2 million gallons a day at a



cost of \$53.37 per million gallons. There is an average daily load of 32,530 pounds of dry solids processed by the plant; 26,210 pounds are removed and 6,320 pounds are dumped into the river (Fig.11) approximately one mile upstream from the North Waverly Road bridge.

Sewage Outfall Lansing Sewage Plant

Figure 11

²⁵Interview with Lansing Board of Water and Light Chemist, October, 1963.

²⁶Report of Lansing Sewage Treatment Plant, Sewage Treatment Division, Public Service Department, (City of Lansing, Michigan, 1960-62).

This daily load contains 462 ppm of five-day biochemical oxygen demanding material²⁷ and taxes the capacity of the river to the limit. During periods of low flow the limits are probably exceeded.

The Lansing Board of Water and Light as of June, 1962 had seventy-five million dollars invested in electric and steam-heat plants which produced 801,388,832 kilowatt hours of electricity and 1,500,000 pounds of steam worth \$15,215,464.²⁸

The plants use 213 cfs of water to cool condensers on three turbines. This water is taken from the impoundment, circulated through the condensers and returned to the river below the dam. The temperature of the water as it leaves the condensers is nearly 100° Fahrenheit and would be extremely harmful to the river during the summer months when the river temperature is already 70 to 80° F. and the flow is at a minimum.

At this time the waste water is circulated through cooling towers, which reduce the temperature about 15° F., and then returned to the impoundment. It will again be circulated

²⁷Five-day biochemical oxygen demand. The amount of oxygen expressed in parts per million required for the stabilization of organic material during a five-day incubation period at 20 degrees centigrade.

²⁸Annual Report, Board of Water and Light, Lansing, Michigan, Covering the Operation of the Water, Electric, and Steam-heat Utility for the Year Ending June 30, 1962.

from the impoundment through the condensers and only the water lost by evaporation in the towers, about one to three percent, will be needed from the flow of the river. Thus the normal minimum flow of water, at no greater than normal maximum temperatures, is maintained in the river at all times.

The cooling towers are operated from June to October and cost \$100 per day each. The city is currently spending \$45,000 a year to prevent temperature pollution in the river.

A fourth generator is being installed with its cooling tower. The additional volume of water, 71 cfs will be more than the river can supply except for short periods of time and the system will function continuously without using river flow except for the one to three percent needed to make up the tower loss.

The velocity of the water is sufficient to flush sediments through the condensers. However, chlorination with sixty-three pounds of gas per day, is necessary to prevent algae growth.

The Tri-County Study Commission reports that there is a 2° temperature increase in the impoundment and a slight drop in oxygen content. The recreational benefits exceed any damage that may occur from these causes.²⁹

The river has about three miles of residential development along its course through town and the condition

²⁹ Preliminary Report, Tri-County Study Commission.

of these banks depends more or less on the age of the development.

In the older areas such as from Island Street to Elm Street and from Saginaw Street to Willow Street, houses squat on the banks, their owners scarcely recognizing its presence except when disposing of all manner of debris.

The homes on Moore's River Drive, from Logan Street to the Lansing Country Club, are in the oldest exclusive subdivision along the river. The land is high, well landscaped and cared for and the assessed values are among the highest in Lansing, estimated at \$100 per front foot.

On the other bank and upstream from Moore's River Drive is the Waverly Heights subdivision extending one-half mile below the South Waverly Road bridge. Fig. 12.



Fig. 12

Waverly Heights Sub-
division Lansing



Fig. 13

Moores Park Impoundment
at Francis Park

This is probably the most desirable stretch of river in Lansing. The shoreline slopes gently up from the water which is deep enough and wide enough for boating and most of these home owners have boats and make good use of the river. This property is assessed at an estimated \$45 per front foot.³⁰

Farther upstream and outside the city limits a new subdivision has been layed out along the west bank of the river from Crietz Road south. This is an exclusive project with lots costing \$100 per front-foot and the first home constructed costing an estimated \$70,000. A canal has been dredged into the subdivision creating twenty-seven waterfront lots in addition to the twenty lots along the river proper. The agency selling these lots believes that the conditions

³⁰ Interview with the City of Lansing Tax Assessor, October, 1963.

in the river make it necessary to expend more effort on each sale but admits that the asking price is tops for the Greater Lansing area. The agency is doubtful that lots of this kind could be sold at a higher price regardless of the state of the river.

On the northwestern edge of town along the least desirable strip of river, just two miles below the outfall of the city sewage disposal plant, is another new and exclusive subdivision. Sixteen lots at the riverside are priced at from \$65 to \$100 per front-foot. One of the cheaper lots, \$6,500, has been sold and a house built worth an estimated \$30,000 to \$40,000. Again, the developers consider the condition of the river to be detrimental to the sale of lots but admit that their prices are as high as can be charged for any residential land in this area.

The fact that Waverly Heights is on the cleanest section of the river which provides boating, swimming and fishing has not added noticeably to the value of this property over that near the outfall.

The recreational use of the river is, for the most part, confined to the impounded waters above the dam. However, children are drawn to water regardless of its state of pollution and, as expected, children were found playing beside this river, exploring the wooded banks and even fishing the grossly polluted water just below the sewage outfall.

One of three city parks--the Lansing Recreational Area--is located downstream from the North Waverly Road bridge with picnicing facilities and playgrounds well back from the river but with nature trails extending in both directions along the natural levees at the river's edge. The park is well attended during the summer months although little actual use is made of the river.

Moore's Park, located just below the dam, is a nicely wooded area equipped with picnic tables, playground equipment and an outdoor swimming pool. Its shaded space beneath a canopy of maples attracts the public much more than its location along the river which has a little to offer at this point.

Across the stream is the City Light Plant and the Oldsmobile factory offering nothing of scenic value. The dam which might be attractive is rendered lifeless as the total flow of the river is gulped in by the light plant and spewed out downstream. Only during periods of high flow does any water pass over the dam and these periods do not occur when the park is in use.

Francis Park is the third major park and is located one mile below the South Waverly Road bridge. This is the most popular park of the three, spreading out along the impoundment and taking advantage of scenic beauty along its shores and across its waters. The park has no facilities

for swimming or boating but the low banks invite the fishermen, just as the tables and grills and playgrounds do the families of picknickers.

Boating is perhaps the most important recreational use of the river and on a summer day traffic may extend from Logan Street to the village of Dimondale nine miles upstream.

Much of the traffic originates at the Lansing Boat Club where 150 members own seventy boats. The club is



Fig. 14

Lansing Boat Club

located between the Waverly Heights subdivision and the city park about one mile below the Waverly Road bridge, on the west bank of the impoundment. Sixty-five boats are maintained more or less permanently on the river, kept in slots constructed by the owners along 200 feet of riverbank

leased from the city. Between April and September of 1963 the club pumped 4,000 gallons of gasoline.

The newly constructed launching facilities in the city park adjacent to the boat club will undoubtedly

contribute considerably to the growing traffic on the river. (Fig. 15). These ramps were completed about mid-summer, 1963, and were immediately put to use, extending boating enjoyment to many more Lansing residents.

The only commercial use of the river in this area is the Grand-R-Marina, a new business opened in the Spring of 1963 down stream from the Creitz Road bridge. It is an agency for the popular makes of boats and Mercury outboard engines, has the customary service department, and rents fishing boats, canoes, and runabouts. Six thousand gallons of gasoline were pumped between April and September of



Fig. 15

City Ramps

1963 by this prospering new business. The number of fishing boats to rent will be increased from four to twelve next year and the volume of sales, which the owners are quite satisfied with, is expected to increase substantially.



Fig. 16 Grand-R-Marina

Being able to demonstrate boats and motors has contributed greatly to the success of the business.

Wherever a dock or a bridge or a high bank or a leaning tree elevates a boy above the water sufficiently to generate a little excitement on the way down, sooner or later a neighborhood gang will stake out its right to the "old swimming hole." There are many of these in the Grand River in spite of the fact that swimming in any part of the river is a questionable practice. Kids swim and bigger kids water ski and the river is often full of kids who are fortunate to have the required depth of water in those stretches of the river which are least contaminated and which at least give an appearance of being clean. The Ingham County Health Department in October, 1963 knew of no instances in which anyone had suffered from swimming in the river. They recognize the hazard from the storm sewers and check the water regularly but have not recently posted against swimming.

Swimming and skiing seems to be more acceptable than fishing, or at least eating the fishes caught in the river. Fishing is not a popular sport in this river, although it is not uncommon to see fishermen along the banks, usually after carp. The general attitude seems to be that fishing is hardly worth while in a stream where contamination makes the fish inedible. Few fishermen who were interviewed admitted to eating their catches.

The Grand River brings more to the Lansing area than just boating enjoyment and picknicking pleasures. There is a considerable amount of money returned to the city from the recreational uses. How much is derived annually from boating, fishing, picknicking and other uses is difficult to assess accurately. However, estimates can be made well within the realm of reason which are indicative of the amounts spent in the Lansing area and also of the vast sums spent throughout the state.

Swimming contributes very little, if anything, to the picture. There are few swimmers and no commercial beaches and the amount of money involved is small. The values accruing to Lansing from existing parks and recreation areas will probably never be completely appreciated, but it is certain that they contribute much to the land values and industrial site values, to say nothing of the rest and relaxation which they provide for the community.

More accessible are the values involved in fishing and, although the sport is not popular at this time, the potential is well worth looking at. In arriving at the following estimate of potential income from fishing, the following assumptions were necessary:

1. That fishermen tend to fish in the nearest available water, limiting the area of this study to four townships--Lansing and Delhi in Ingham County and Delta and Windsor in Eaton County.

2. Assuming that each fisherman will fish at the nearest point on the river within his township, the distance traveled is assumed to be one-half the greatest distance to the river and return.

3. That one-half of the fishermen will rent boats at \$4.00 per day.

4. That each fisherman will spend a dollar per day for bait, tackle or similar items and ten cents per mile for transportation.

5. That one-half of the total licensed fishermen will spend one day on the river per season.

The 1960 census shows 209,586 persons in Ingham County with 122,194 or 58% residing in Lansing city or township; 11,772 or 5.9% reside in Delhi Township. In June of 1963 there were 18,000 fishing licenses held in Ingham County of which 58% or 10,440 are assumed to be in Lansing and 5.9% or 1,062 in Delhi Township.³¹

According to the census Eaton County has 24,878 persons with 6,864 or 27% in Delta Township and 2,414 or 6.7% in Windsor Township. In June of 1963 Eaton County had 6,978 fishing licenses with 27% or 1,884 in Delta Township and 7.6% or 530 in Windsor Township.

The Lansing area then, as defined above, has 13,915 licensed fishermen, half of whom will spend one full day on the river. These 6,957 fishermen will travel an estimated

³¹Michigan Department of Conservation Report 1355, 1962 License Sales by County.

32,436 miles to reach the river at a cost of \$3,244 and will spend \$6,957 for bait. The 3,478 who rent boats will spend \$13,912. All told, these 6,957 people will spend an estimated \$24,113 with Lansing businesses.

Boating on the river presents a more impressive figure and one more easily and surely arrived at.

The Lansing Boat Club maintains sixty-five boats more or less permanently on the Grand River all summer. These boats are no doubt used in other waters at times and may have been purchased for use throughout the state rather than for exclusive use on the river. However, during the 1963 season they were lodged at the club and spent more hours here than elsewhere.

This study will assume that the boats were purchased for use on this river and the annual cash value is estimated

as follows:	65 boats @ \$1,150 ³²	\$74,750
	Estimated 10% annual expenditure	\$7,475
	35 trailers @ \$150	5,250
	4,000 gallons gas @ 35¢	1,400
	1,000 quarts of oil @ 55¢	550
		<u>\$14,670</u>

³²The Inland Marine Department of Auto Owners Insurance Company surveyed 250 small boat policies to arrive at an actual cash value average of boats and motors insured by the company. The policies covered all makes and models and all ages of boats up to a total value of \$5,000 cost price new. The average value of these boats, motors and accessories was \$1,150. Half of the policies also had trailers worth an average \$150. The stated value on boat policies is automatically depreciated 10% a year.

In addition to these expenditures are those made at the Grand-R-Marina during the same period:

6,000 gallons gas @ 35¢	\$2,100
1,500 quarts oil @ 55¢	825
	<u>\$2,925</u>

A reasonable estimate of the annual boating expenditures on the river would be \$17,595. If the boat club's average gas consumption of fifty-seven gallons per boat per season is taken as standard, the 6,000 gallons pumped at Grand-R-Marina would service 103 more boats and represent an additional investment of \$133,900 including trailers.

Without doubt this investment would be made regardless of the river, but the equipment is used on the river and its purchase must have been influenced by the river, perhaps by no more than a pleasant memory of others racing up and down the waters or, as the owners of the Grand-R-Marina suggest, from an immediate and thorough demonstration on the river. The amount might be considered as potential and the 10% depreciation of \$13,390 added to the \$17,595 for an expected annual expenditure of \$30,985.

It is apparent that the income from the recreational uses of the Grand River is not equal to the annual expenditures the city makes on pollution abatement. However, the assessable values do not by any means represent the total values involved. As suggested above, there are hidden values such as job opportunities resulting when factories and businesses locate near the recreational facilities. There

is the value in civic pride, peace of mind and improved general welfare of the public, promoted through the beauty, rest and recreation associated with water resources.

Barton Lake

Barton Lake is a 200-acre lake in Kalamazoo County, six miles south of the village of Vicksburg, with a long history of pollution from the local paper mill and Vicksburg's sewage disposal plant. Gourdneck Creek, the inlet to Barton Lake, passes through Vicksburg carrying the effluent from the sewage plant and a daily average load of 760 pounds of suspended solids from the Lee Paper Company. (Fig. 18). On the southern side of the village the paper company operates a settling plant which removes titanium oxide and cellulose fibers and other suspended matter to the satisfaction of the Water Resources Commission (WRC). The nutrient materials remain in the water and are carried to the lake. This continuous fertilization of the lake has produced rapid expansion of weed beds and periodic algae blooms to the consternation of the cottage owners.



Fig. 18

Gourdneck Creek Vicksburg

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The record of the situation begins in 1953 when the resident landowners about the lake complained of cloudy waters and decaying mats of vegetation. The WRC conducted surveys on 8/12/53 from which it was concluded that the inlet, Gourdneck Creek, was polluted to the extent that no living organism could survive from the point of pollution--Lee Paper Company--to the lake. A delta of paper waste, extending 200 feet into the lake, supported no bottom organisms, and the lake bottom was covered by a grey flocculent deposit which had reduced the production of the normal bottom organisms. The WRC ordered the Lee Paper Company to install settling plants to remove the suspended matter.

On May 16 and July 22 of the following year the lake was surveyed to determine the effectiveness of the settling plants. Transparency, as revealed by Secchi disk, was six feet at the mouth of the creek and thirteen feet at the most distant point. There was 2.5 ppm dissolved oxygen at the mouth of the creek and 6 ppm BOD. Oxygen values in the lake proper were reported "not severely affected by the organic wastes". On the basis of this report the settling plant was pronounced effective and the situation satisfactory.

The WRC received complaints in July, 1961 of "white stringy wastes" floating about the lake. A survey of the situation revealed that four species of plankton algae, Oscillatoria sp., Soelosphaerium sp., Anabaena sp., and Lyngbya sp. all of the blue-green algae family, were reproducing at an accelerated rate. Transparency at the mouth of

Gourdneck Creek had dropped to twenty inches by Secchi disk and the water throughout the lake was "colored". There was a grey cast to the green of the algae from titanium oxide present.

Coliform readings in the system varied from 23,000 MPN³³ in the creek to 36 MPN at the most distant point in the lake from the creek, and mats of dead and decaying algae floated about before the wind trailing the "stringy white waste" and oozing milky fluids. The mats were easily mistaken for floating paper wastes and complaints were lodged against the paper company.

Gourdneck Creek was found to be full of the algae and the fungus--Actinomyces sp. It was concluded that spores entered the lake where ideal conditions--proper temperature, calm surface and an extremely high level of nutrient--all acted jointly to produce the growth of algae and fungus. A report of the situation recognized that any time there was a recurrence of these conditions a similar situation might occur. No action was taken by the WRC.³⁴

³³Escherichia coli, one of the coliform group of bacteria found in the feces of humans, easily discovered, its presence is considered indicative of pollution. The degree of pollution is estimated in most probable numbers (MPN) bacteria per 100 milliliter.

³⁴"Observations on Barton Lake, Vicksburg, Michigan", 6/27/57, 9/17/58, 10/17/62 Carlos Fetterolf, Aquatic Biologist, WRC.

The current problem continues to be the periodic plankton blooms and spreading weed beds (Fig. 19) that fan out from the mouth of Gourdneck Creek and threaten to choke the outlet, Portage Creek (Fig. 20) completely. During periods of high winds, weeds and algae are concentrated into floating mats and blown ashore, where they accumulate in windrows, rot and produce objectionable odors.

The suspended solids which pass through the settling tanks continue to accumulate on the delta region and in Portage Creek. During the spring thaw the winter's



Fig. 19
Weed Beds. Northeast
End Barton Lake

accumulation of sediments frozen in the ice is released and flushed out. Portage Creek runs white for several days. Most of the year the suspended matter is barely noticeable and the system appears relatively clean and clear.



Fig. 20
Portage Creek Outlet Barton Lake

The resident owners and others using the lake are very critical of conditions in the lake. They have recently become aware of the spreading weed beds and have learned about the nutrient levels in the water which causes their problem. Recurring algae blooms cause the greatest reaction in the community and inevitably produce one or more complaints to the WRC and seemingly endless discussion around the lake. However, there is no other apparent effect from pollution in this lake.

The lake is about one-quarter developed, with seventy-five well-cared-for cottages along its shores. The remaining shoreline is owned by an individual who so far has refused to sell any part of the land. The last available lot was sold in 1963 for \$4,800, a price considered reasonable by the real estate agent making the sale.³⁵ There are no cottages for sale at present on the shores of the lake. However, land immediately behind existing cottages is currently being developed and future owners will have access to the lake at a public fishing site.

The lake has supported two boat liveries until recently. Mr. John Clark, with six boats and one cottage to rent, is very critical of pollution in the lake but stated that it has had no effect on his business. He continues to rent boats and the cottage satisfactorily.³⁶

³⁵Direct communication Erving Morely, Vicksburg, Michigan, October 1963.

³⁶Direct communication with Mr. John Clark and Mr. Edward Harms, September, 1963.

The other livery was closed in 1962 when Mr. Edward Harms retired and found his income more than social security would allow. Mr. Harms said his beaches usually received large quantities of algae blown ashore by the winds. The algae nuisance had caused him to complain repeatedly to the WRC but his business had remained constant through out the last several years in spite of pollution in the lake.

Fishing in the lake is reported to be good by the local people, although some complain of a decrease in the size of pan fish.

Pollution, real or imaginary, has made no change in the usage of Barton Lake. People swim in it, fish in it, boat on it, and remain just as eager to buy lots along its shores. Still fertilization continues and weeds spread, algae blooms come and go and the process destroys a lake.

There are future costs involved in the destruction of bodies of water through pollution such as rehabilitating lakes fertilized into senility, reconstructing river banks and channels choked with sediment and the purification of waters loaded with chemicals. Until it becomes necessary to undo these kinds of damage in our lakes and streams, the cost can only be guessed at. It is reasonably certain, however, that the longer the damaging forces continue the greater will be the cost of repair, and that someday we will be faced with the choice of reconstruction or doing without.

IV. CONCLUSIONS

This study indicates that public reaction to polluted water is an unpredictable thing and an unsound basis for water management policy. It reveals the public as being far more tolerant of pollution than management policy can rightfully be, providing the objectives of management include the preservation of existing bodies of water.

The study reveals a public frequently unaware of pollution but generally unconcerned because of a lack of understanding or a lack of esthetic appreciation. The problem is primarily one of esthetics rather than of economics.

The major difficulty in the problem of pollution as it affects the recreational uses of water has little to do with water chemistry, aquatic biology, acreages, shorelines or any other technical aspect of water management. It is primarily caused by the attitudes of the people who use the water. The major difficulty is that too few people care about conditions existing in the waters and willingly settle for available bodies of water and whatever pollution they contain. This difficulty transects many aspects of society and involves much more than water and recreation.

There is a despotic philosophy of property rights revealed by a widespread emphasis on the rights of property with little regard for the responsibilities attendant to those rights. It is frequently demonstrated by the riparian

owner who claims all rights to the stream even to the destruction of the stream bed if it suits his purpose.

It is reflected in the public's attitude toward state ownership which seems to imply that public property rights focus on the individual while public responsibility is widely distributed throughout the population. It gives the individual the right to toss a tin can in the creek but requires "the State" to pick it up.

The difficulty is also that in this society most people believe that "you get what you pay for". What we pay for recreational uses of water is not very much and these uses, available to anyone, are apparently not held in very high esteem in spite of the talking we do to the contrary.

There is little evidence that esthetic values are very widely appreciated and, in spite of the popularity of some so-called outdoor sports, one wonders if these sports--driving or boating, for instance--are popular because of the outdoors or because of an urge to manipulate a powerful and fast vehicle.

The answers to these problems are basically in public education--creating in the public an appreciation for the intangible values of waters, improving public taste and producing in the individual a respect for public properties.

Part of the program must continue to be a dissemination and explanation of facts--the role of fertilization in the aging processes of lakes, the general principles of

ecology, descriptions of aquatic habitat and the effects on each of the various forms of pollution.

Riparian owners must know and appreciate the difference between a living dynamic water system and a lifeless ditch or puddle.

This kind of information can best be disseminated through the mass media. Television should be effective since TV programs are most easily presented in an entertaining way. Children's programs such as Culver's Clubhouse and Mr. Wizard can demonstrate ecological principles and the effects of pollution.

Science reporting, a recent addition to TV programming, has already included coverage of fishes and commercial fisheries and will no doubt cover other allied subjects. TV watching seems to be a habit and much information can be presented in small doses or disguised sufficiently to be acceptable to audiences of a wide range of interests.

Special reports, the "White Papers", if not conclusive, at least bring certain aspects of the problem before the public.

The greatest need of all is in upgrading public esthetic values and there is no easy method for this. It will come, if it does, through the combined efforts of those in various fields--city planners, architects, and conservationists as well as professional artists, literary people, entertainers, and others--all of whom have an effect, good

or bad, on the public tastes, and will also effect this problem. More can be done by State and Federal agencies. The public is strongly cost conscious when it comes to public spending. Therefore a specific tax--litter tax or pollution tax--might supply money for reducing pollution both directly and indirectly. It could provide funds for cleaning litter from streams and lakes, rehabilitation of lakes and shorelines and for research in waste disposal and water management as well as bringing to the attention of the people dollar values of the resource involved. Although it is generally true that water value reduced to a dollar-and-cents basis cannot compete with values of water in industry or municipalities, still the amount of money involved in recreation is large and these figures could be used to publicize the importance of recreational uses to the society.'

Inspite of this tendency to demand concrete reasons and practical solutions, the preservation of water for recreational uses so far defies practical reasoning. There is no economic argument for pollution control, nor practical reason why lakes or streams or virgin woodlots or any other specific plant and animal association should be preserved. The problem, however practical the approaches, sooner or later resolves itself into lofty ideals and impractical solutions. As Claus J. Murie says, the real issue in conservation is the saving of animals and wilderness because they are interesting and have spiritual value. These reasons give the only basis for permanent solution of the problems.

The laws of the state reflecting the attitudes and desires of the people are deficient in much the same areas and reflect the same lack of knowledge and judgment on the part of legal people and legislators.

The definition of pollution needs clarification and expansion. There is a need for clearly defined standards of water quality, uniform for all waters in the State and broad enough to provide for the protection of the intangible values. Water standards will be difficult to establish. Reasonable standards seem possible and existing laws, which cover most forms of pollution, should be interpreted on the basis of demonstrable fact rather than on public reaction.

Existing laws could be more effective if their interpretation was directed more strongly toward private responsibilities in ownership and the peoples rights. The reasonable use doctrine on which water laws are administered is predicated on a sophisticated knowledge and appreciation of water and water values in the users which seldom exists. Until this knowledge and understanding is created the public law and the interpretations of law must take their place.

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