

BACKGROUND CONSIDERATIONS

A river is a dynamic system, always being influenced by and, in turn, influencing its environment. The "environment" of the river includes man and his activities as well as the forces of nature. The following are brief discussions of various environmental factors which affect the water quality of the Pine River below Alma and St. Louis, Michigan.

A. Geography

1. Basin Description

The Pine River is part of the Saginaw River Basin, the largest in the state. The Pine is tributary to the Chippewa River approximately three miles upstream from the confluence of the Chippewa with the Tittabawassee River. The Tittabawassee, in turn, is the major tributary of the Saginaw River.

The Pine River drains approximately 403 square miles of Michigan's lower peninsula. The river basin is relatively long and narrow, being approximately 60 miles long and 15 miles across at its widest point. The basin is roughly "V" shaped with the river flowing generally southeast from Mecosta County in the upper portion of the basin, through Isabella and Montcalm Counties, and into Gratiot County. The river then changes direction in Summer Township of Gratiot County and flows northeast into Midland County where it joins the Chippewa River. The Pine's major tributaries are Skunk Creek and the North Branch of the Pine River in the upper portion of the basin and the West Branch of the Pine River, Bush Creek, and Sucker Creek in the lower portion (See Figure 1).

The two major population centers in the basin, both located on the river, are Alma and St. Louis. Approximately 70% of the area drained by the Pine is upstream from these communities.

2. Land Use

Present land use in the Pine River basin consists primarily of cultivated agriculture and associated land practices such as nurseries, sod farms, and golf courses. Figure 2 illustrates the percentage of cropland harvested by township. Over two-thirds of the basin area has some form of artificial drainage. Much of the land not farmed consists of woodland. Figure 3 illustrates the percentage of forested land in the various counties of the basin.

Oil and gas production are minor land uses in the basin. (page).

QUALITY STANDARDS

6 TOTAL DISSOLVED SOLIDS (mg/l)	7 NUTRIENTS Phosphorus, ammonia, nitrates and sugars	8 TASTE & ODOR PRODUCING SUBSTANCES	9 TEMPERATURE (°F)	10 HYDROGEN ION (pH)	11 RADIOACTIVE MATERIALS																								
Total Dissolved Solids: Shall not exceed 500 as a monthly average, nor exceed 750 at any time. Chlorides: The monthly average shall not exceed 75, nor shall any single value exceed 125.	Nutrients originating from industrial, municipal, or domestic animal sources shall be limited to the extent necessary to prevent adverse effects on water treatment processes or the stimulation of growths of algae, weeds and slimes which are or may become injurious to the designated use.	Concentrations of substances of unnatural origin shall be less than those which are or may become injurious to the designated use. Monthly average phenol concentration less than 0.002 mg/l - maximum concentration limited to 0.005 mg/l for a single sample.	The maximum natural water temperature shall not be increased by more than 100°F.	pH shall not have an induced variation of more than 0.5 unit as a result of unnatural sources.	An upper limit of 1000 picocuries/liter of gross beta activity (in absence of alpha emitters and Strontium-90). If this limit is exceeded the specific radionuclides present must be identified by complete analysis in order to establish the fact that the concentration of nuclides will not produce exposures above the recommended limits established by the Federal Radiation Council.																								
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Less than 700 dissolved minerals. Maximum percentage of sodium 40% as determined by the formula $\frac{Na \times 100}{(Na + Ca + Mg + K)}$ when the bases are expressed as milliequivalents per liter.	Nutrients originating from industrial, municipal, or domestic animal sources shall be limited to the extent necessary to prevent the stimulation of growths of algae, weeds and slimes which are or may become injurious to the designated use. NO ₃ concentrations shall conform to USPHS Drinking Water Standards.	Concentrations of substances of unnatural origin shall be less than those which are or may become injurious to the designated use.	Not applicable	pH shall not have an induced variation of more than 0.5 unit as a result of unnatural sources.	An upper limit of 1000 picocuries/liter of gross beta activity (in absence of alpha emitters and Strontium-90). If this limit is exceeded the specific radionuclides present must be identified by complete analysis in order to establish the fact that the concentration of nuclides will not produce exposures above the recommended limits established by the Federal Radiation Council.																								
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COMMISSION OBJECTIVE:

WATERS IN WHICH THE EXISTING QUALITY IS BETTER THAN THE ESTABLISHED STANDARDS ON THE DATE WHEN SUCH STANDARDS BECOME EFFECTIVE WILL NOT BE LOWERED IN QUALITY BY ACTION OF THE WATER RESOURCES COMMISSION UNLESS AND UNTIL IT HAS BEEN AFFIRMATIVELY DEMONSTRATED TO THE MICHIGAN WATER RESOURCES COMMISSION THAT THE CHANGE IN QUALITY WILL NOT BECOME INJURIOUS TO THE PUBLIC HEALTH, SAFETY, OR WELFARE, OR BECOME INJURIOUS TO DOMESTIC, COMMERCIAL, INDUSTRIAL, AGRICULTURAL, RECREATIONAL OR OTHER USES WHICH ARE BEING MADE OF SUCH WATERS, OR BECOME INJURIOUS TO THE VALUE OR UTILITY OF RIPARIAN LANDS; OR BECOME INJURIOUS TO LIVESTOCK, WILD ANIMALS, BIRDS, FISH, AQUATIC LIFE OR PLANTS, OR THE GROWTH OR PROPAGATION THEREOF BE PREVENTED OR INJURIOUSLY AFFECTED; OR WHEREBY THE VALUE OF FISH AND GAME MAY BE DESTROYED OR IMPAIRED, AND THAT SUCH LOWERING IN QUALITY WILL NOT BE UNREASONABLE AND AGAINST PUBLIC INTEREST IN VIEW OF THE EXISTING CONDITIONS IN ANY INTRASTATE WATERS OF MICHIGAN.

WATER WHICH DOES NOT MEET THE STANDARDS WILL BE IMPROVED TO MEET THE STANDARDS.

WATER

<p>PARAMETERS USES</p>	<p>1 COLIFORM GROUP (organisms/100ml or MPN)</p>	<p>2 DISSOLVED OXYGEN (mg/l)</p>	<p>3 SUSPENDED, COLLOIDAL & SETTLEABLE MATERIALS</p>	<p>4 RESIDUES (Debris and material of unnatural origin and oils)</p>	<p>5 TOXIC & DELETERIOUS SUBSTANCES</p>
<p>A WATER SUPPLY (1.) DOMESTIC Such as drinking, culinary and food processing.</p>	<p>The monthly geometric average shall not exceed 5000 nor shall 20% of the samples examined exceed 5000, nor exceed 20,000 in more than 5% of the samples.</p>	<p>Present at all times in sufficient quantities to prevent nuisance.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating Solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Conform to current USPHS Drinking Water Standards except: Cyanide: Normally not detectable with a maximum upper limit of 0.2 mg/l. Chromium6: Normally not detectable with a maximum upper limit of 0.05 mg/l. Phenol: Limitations as defined under A-8.</p>
<p>(2.) INDUSTRIAL Such as cooling and manufacturing process.</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 5000 nor shall 20% of the samples examined exceed 10,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 1000.</p>	<p>Present at all times in sufficient quantities to prevent nuisance.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Limited to concentrations less than those which are or may become injurious to the designated use.</p>
<p>B RECREATION (1.) TOTAL BODY CONTACT Such as swimming, water skiing and skin diving.</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 1000 nor shall 20% of the samples examined exceed 5,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 100.</p>	<p>Present at all times in sufficient quantities to prevent nuisance.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Limited to concentrations less than those which are or may become injurious to the designated use.</p>
<p>(2.) PARTIAL BODY CONTACT Such as fishing, hunting, trapping and boating.</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 5000 nor shall 20% of the samples examined exceed 10,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 1000.</p>	<p>Present at all times in sufficient quantities to prevent nuisance.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Limited to concentrations less than those which are or may become injurious to the designated use.</p>
<p>C FISH, WILDLIFE AND OTHER AQUATIC LIFE such as (growth and propagation)</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 5000 nor shall 20% of the samples examined exceed 10,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 1000.</p>	<p>At the average low flow of 7-day duration expected to occur once in 10 years the following DO values shall be maintained in rivers capable of supporting: <u>Intolerant fish, cold-water species (trout, salmon)</u> - Not less than 6 at any time; <u>Intolerant fish, warm-water species (bass, pike, pan-fish)</u> - Average daily DO not less than 5, nor shall any single value be less than 4; <u>Tolerant fish (carp, bullheads)</u> - Average daily DO not less than 4, nor shall any single value be less than 3; <u>Principal anadromous fish migrations in warm-water rivers</u> - Not less than 3 during migrations.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Not to exceed 1/10 of the 95-hour median tolerance limit obtained from continuous flow bio-assays where the dilution water and toxicant are continuously renewed except that other application factors may be used in specific cases when justified on the basis of available evidence and approved by the appropriate agency.</p>
<p>D AGRICULTURAL Such as livestock watering, irrigation and spraying.</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 5000 nor shall 20% of the samples examined exceed 10,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 1000.</p>	<p>At greater flows the DO shall be in excess of these values. For lakes see discussion, page 26 Not less than 3 at any time.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Conform to current USPHS Drinking Water Standards as related to toxicants. Toxic and deleterious substances shall be less than those which are or may become injurious to the designated use.</p>
<p>E COMMERCIAL AND OTHER Such as industrial cooling, hydraulic lifts, and other operations where the ground and water are not suitable for agriculture or other uses.</p>	<p>The geometric average of any series of 10 consecutive samples shall not exceed 5000 nor shall 20% of the samples examined exceed 10,000. The fecal coliform geometric average for the same 10 consecutive samples shall not exceed 1000.</p>	<p>Average daily not less than 2.5, nor any single value less than 2.</p>	<p>No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with the designated use.</p>	<p>Floating solids: None of unnatural origin. Residues: No evidence of such material except of natural origin. No visible film of oil, gasoline or related materials. No globules of grease.</p>	<p>Limited to concentrations less than those which are or may become injurious to the designated use.</p>

DESIGNATED USES OF THE PINE RIVER

The Michigan Water Resources Commission adopted Intrastate Water Quality Standards on January 4, 1968, to protect and enhance the quality of Michigan's inland waters. The standards specify water quality parameters and designate specific water uses to be protected in particular reaches of streams and rivers. Where multiple use classifications exist, the most restrictive parameters shall apply. The standards apply at all stream flows equal to or exceeding the 10-year recurrence of minimum low flow of 7-day duration. Water which does not meet the standards will be improved to meet the standards.

The presently adopted uses for various reaches of the Pine River are:

Domestic Water Supply - [a raw water supply suitable for use as a potable supply after conventional treatment] - At Alma.

Industrial Water Supply - [manufacturing processes other than food processing] - Upstream from M-46, Business Route US-27 bridge in St. Louis.

Recreation - Partial Body Contact - [hunting, fishing, boating, etc.] - Entire river.

Fish, Wildlife, and Other Aquatic Life - Intolerant Fish, Warmwater Species - [bass, pike, panfish, etc.] - Upstream from M-46, Business Route US-27 bridge in St. Louis.

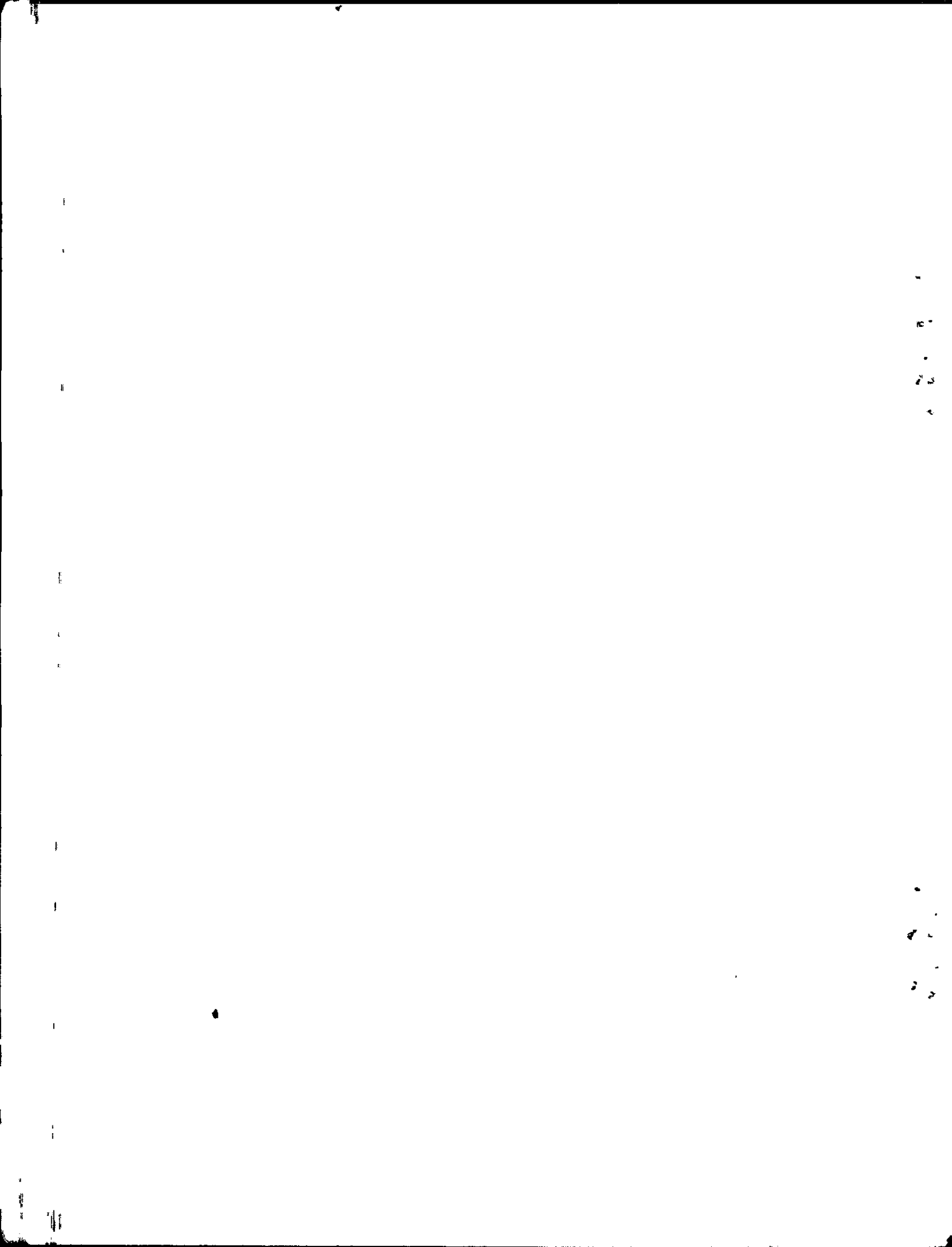
*Fish, Wildlife, and Other Aquatic Life - Tolerant Fish, Warmwater Species - [carp, bullheads, etc.] - From M-46, Business Route US-27 bridge in St. Louis downstream to its confluence with the Chippewa River.

Agricultural - [irrigation, stock watering, etc.] - Upstream from M-46, Business Route US-27 bridge in St. Louis.

*Commercial and Other - [navigation, power generation and uses not included elsewhere in standards] - From M-46, Business Route US-27 bridge in St. Louis downstream to its confluence with the Chippewa River.

The water quality parameters to protect various designated uses are shown in Chart 1 on the following pages.

*NOTE: The Tolerant Fish, warm-water species and Commercial and Other use designations that currently apply to the reach of the Pine River from the M-46, Business Route US-27 bridge in St. Louis downstream to its confluence with the Chippewa River were reviewed by the Commission and public hearings were held. On October 16, 1970 the Commission upgraded these use designations [effective on or before January 1, 1974] to Intolerant Fish, warm-water species and Agricultural.



second (cfs). Calculations show that at the design flow (10-year recurrence of minimum low flow of 7-day duration = 26 cfs at Alma), a complete lack of oxygen would be expected in a portion of the Pine River between Alma and St. Louis and also for several miles downstream from St. Louis.

Photosynthesis and respiration of aquatic vegetation in the Pine River downstream from St. Louis have a significant effect on DO concentrations in the river. Oxygen released by plant photosynthesis during daylight hours causes supersaturated DO concentrations in the afternoon. During night hours, respiration dominates and DO is removed from the river. Thus, low DO concentrations occur in the river during morning hours, even though the daily average is well above the present minimum allowable average value of 4 mg/l at all locations.

The upgraded use designations will require an average daily DO of not less than 5 mg/l with no value less than 4 mg/l.

2. Total Dissolved Solids. Concentrations of total dissolved solids are satisfactory for the present designated uses of the Pine River. However, they exceed the 700 mg/l maximum allowable concentration for the upgraded agricultural use designation downstream from the Michigan Chemical Company.

3. Settleable Materials. Unnatural sediment deposits have accumulated in the St. Louis impoundment in the vicinity of Michigan Chemical Company's outfalls. The deposits are visible for about 150 feet into the river. Benthic biological activity has been destroyed in underwater portions of the impoundment. This does not meet present or upgraded standards.

4. Hydrogen Ion (pH). Samples collected in 1970 showed that the pH variation in the mile of the Pine River between M-46 and Mill Street in St. Louis was as great as 0.9 units. Present and upgraded standards state that the induced variation of pH should not exceed 0.5 units.

5. Nutrients. As mentioned above, respiration of aquatic plants in the river downstream from St. Louis contributes to unsatisfactory DO concentrations. The addition of nutrients to the river contributes to the growth of these plants. The primary sources of phosphorus were industries discharging wastes into Horse Creek, along with the Alma WWTP and the St. Louis WWTP. Nitrogen entered the river as ammonia from these three sources and from the Michigan Chemical Company.

6. Coliform Bacteria. Densities of total coliform bacteria exceeded the values allowed in the present standards in the reach of the Pine River below the discharge of the Alma Wastewater Treatment Plant (WWTP).

7. Flow Regulation - Extremely low flows occur in the Pine River below the St. Louis dam at times when water is stored for peak power generation.

SUMMARY AND CONCLUSIONS

The following use designations presently apply to the Pine River:

Domestic Water Supply: At Alma.

Industrial Water Supply: Upstream from the M-46, Business Route US-27 bridge in St. Louis.

Recreation - Partial Body Contact: Entire River

Fish, Wildlife, and Other Aquatic Life - Intolerant Fish, Warm-water Species: Upstream from the M-46, Business Route US-27 bridge in St. Louis. Tolerant Fish, Warm-water Species: From the M-46, Business Route US-27 bridge in St. Louis downstream to its confluence with the Chippewa River.

Agricultural: Upstream from the M-46, Business Route US-27 bridge in St. Louis.

Commercial and Other: From the M-46, Business Route US-27 bridge in St. Louis downstream to its confluence with the Chippewa River.

Upgraded Pine River use designations were established at the October 1970 meeting of the Michigan Water Resources Commission. These are to become effective on or before January 1, 1974. In addition to the present Domestic and Industrial Water Supply designations, the entire river will then be protected for:

Recreation - Partial Body Contact

Fish, Wildlife, and Other Aquatic Life - Intolerant Fish, Warm-water Species

Agricultural

Higher dissolved oxygen and lower total dissolved solids concentrations will be required downstream from the M-46, Business Route US-27 bridge in St. Louis when the new standards take effect. Surveys in August 1967 and September 1970 found the following unsatisfactory conditions to exist in the Pine River.

1. Dissolved Oxygen. Dissolved oxygen (DO) concentrations fall below the present minimum allowable value of 3 milligrams per liter (mg/l) in portions of the river during the hours just before and after sunrise. The effect was more pronounced in 1970 when DO concentrations less than 3 mg/l were observed for a stretch of about four miles in the river downstream from St. Louis. The river flows during both 1967 and 1970 surveys were approximately 100 cubic feet per

INTRODUCTION

The Michigan Water Resources Commission adopted quality standards for inland waters on January 4, 1968. These standards designate the particular use or uses for which a stream or lake sector will be protected. The intent of the standards program is both to protect existing desirable use and to improve the quality of water where it does not now support desirable use consistent with Michigan Act 245, Public Acts of 1929, as amended.

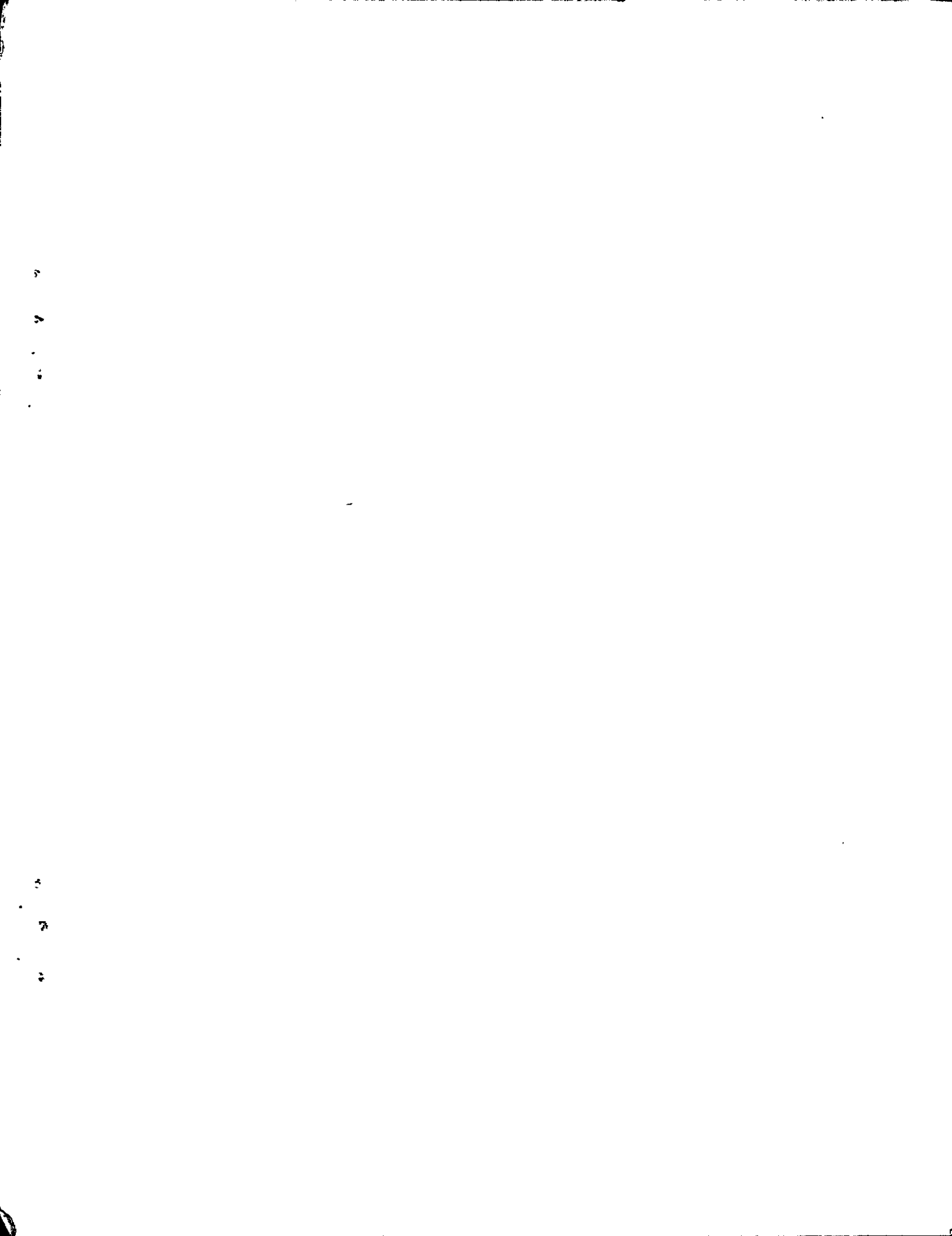
The Water Resources Commission systematically reviews both the water quality standards and the designated use areas as technical knowledge increases and as changing conditions and water use patterns demand. The designated uses of the Pine River from the M-46 Bridge in St. Louis downstream to its confluence with the Chippewa River in Midland County were recently reviewed and upgraded by the Commission at its October 1970 meeting.

The communities of Alma and St. Louis are the two major population centers in the Pine River basin. Wastewater outfalls from these communities and from the Lobdell-Emery Manufacturing Company; Leonard Refineries, Inc. ; the Alma Products Company; and the Michigan Chemical Company affect the water quality of the Pine River.

An intensive survey of a 20 mile reach of the Pine River was conducted in August 1967 to: (1) determine the quantity and strength of waste discharges; (2) determine the severity of chemical, physical, bacteriological, and biological degradation of the river caused by these discharges; (3) determine the natural assimilative capacity of the river downstream from the waste discharges; and (4) determine the degree of improvement in waste treatment necessary to protect river water quality for the designated uses of the river. Additional data were collected in September 1970 to determine if any gross changes in water quality had occurred since the 1967 comprehensive study. The results of these surveys are presented in this report.

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