EPA-5-WI-DANE-MADISON-WWTP-78

DRAFT ENVIRONMENTAL IMPACT STATEMENT

WASTEWATER TREATMENT AND DISCHARGE

PART 1

MADISON METROPOLITAN SEWERAGE DISTRICT, DANE COUNTY, WISCONSIN

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

CHICAGO, ILLINOIS

APPROVED BY:

VALDAS V. ADAMKUS
ACTING REGIONAL ADMINISTRATOR

JUNE, 1978

TABLE OF CONTENTS

(Con't.) TABLE OF CONTENTS

(Con't.) TABLE OF CONTENTS

LIST OF TABLES

Table

LIST OF FIGURES

Summary Sheet for Environmental
Impact Statement

Wastewater Treatment and Discharge

Madison, Wisconsin

Draft (X)
Final ( )

Environmental Protection Agency
Region V

Chicago, Illinois

1. Type of Action: Administrative (X)
Legislative ( )

2. Description of Action

The proposed action includes expansion of the existing sewage treatment facilities and construction of advanced waste treatment facilities at Madison Metropolitan Sewerage District's Nine Springs Sewage Treatment Plant. The effluent from this plant will meet NPDES permit requirements. It will be transmitted via the existing pipeline and effluent ditch to Badfish Creek.

3. Summary of Major Environmental Impacts

The water quality and potential beneficial uses of Badfish Creek will be improved substantially from existing conditions. Aquatic habitat conditions are expected to improve gradually as a result of the improved water quality. Maintaining discharge to Badfish Creek will continue diversion of water out of part of the Yahara River. As water use and sewage flow increase in the future, portions of the river could have a negligible flow at certain times. MMSD has proposed a lake level management-flow augmentation program to minimize this impact. Since such a program is out of the scope of this project we have had to assume that local agencies will develop and implement it. Temporary construction impacts such as increases in noise and dust, minor traffic disruption, and erosion and sedimentation will occur in the vicinity of Nine Springs Sewage Treatment Plant. Measures will be taken to minimize these impacts. The manpower, material, energy resources and land used in the construction of the facilities will be unavailable for other uses.

4. Summary of Alternatives Considered in EIS

The alternatives evaluated in the final screening process included:

a. Advanced waste treatment with discharge of the effluent to the Yahara River via the existing pipeline and then via a new extension pipeline.

b. Advanced waste treatment with split discharge of the effluent to the Badfish Creek via the existing pipeline and ditch and to the Yahara River via the existing pipeline and a new extention pipeline

c. Advanced waste treatment with discharge of the effluent to the Badfish Creek via the existing pipeline.

5. Federal, State and Local Agencies and Officials Notified of this Action

Federal Agencies

U.S. Army Corps of Engineers
U.S. Department of Agriculture
U.S. Department of Commerce
U.S. Department of Health, Education and Welfare
U.S. Department of Housing and Urban Development
U.S. Department of Interior
U.S. Department of Transportation
U.S. Environmental Protection Agency
Water Resources Council

Members of Congress

Honorable William Proxmire, U.S. Senate
Honorable Gaylord Nelson, U.S. Senate
Congressman Les Aspin, U.S. House of Representatives
Congressman Robert W. Kastenmeier, U.S. House of Representatives

State

Honorable Martin J. Schreiber
Wisconsin Department of Natural Resources
A-95 State Clearinghouse
State Historical Society of Wisconsin
Department of Agriculture
Bureau of State Planning
Bureau of Environmental Health

Local

Dane County Regional Planning Commission
Dane County Board of Supervisors
Dane County Health Department
Rock County Planning and Zoning
Rock Valley Metropolitan Council
Rock County Department of Environmental Protection
City of Madison
City of Middleton
City of Monona
City of Stoughton
City of Janesville
City of Sun Prairie
City of Beloit
City of Fort Atkinson

Towns of	Albion	Fitchburg	Rutland
	Berry	Madison	Springdale
	Black Earth	Mazomanie	Springfield
	Blooming Grove	Medina	Sun Prairie
	Blue Mounds	Middleton	Verona
	Bristol	Montrose	Vermont
	Burke	Oregon	Vienna
	Christiana	Perry	Westport
	Cottage Grove	Pleasant Springs	Windsor
	Cross Plains	Primrose	York
	Dane	Roxbury	

Villages of	Belleville	Maple Bluff
	Black Earth	Marshall
	Blue Mounds	Mazomanie
	Brooklyn	Mc Farland
	Cambridge	Mount Horeb
	Clinton	Oregon
	Cottage Grove	Palmyra
	Cross Plains	Rockdale
	Dane	Sharon
	Deerfield	Shorewood Hills
	De Forest	Verona
	Hartland	Waunakee

CHAPTER 1

BACKGROUND

A. EXISTING WATER QUALITY FACILITIES AND AGENCIES

The Madison Metropolitan Sewerage District (MMSD) which was organized under Wisconsin Statutes in 1930 is responsible for the transmission, treatment and discharge of wastewaters from the City of Madison, Wisconsin and its surrounding area. The MMSD presently serves a total of three cities, five villages and twenty-six other municipal customers located within ten townships. The District includes approximately 142 square miles and is located entirely within Dane County (see Figure 1-1).

The 36.5 MGD of wastewaters currently generated within the District receives secondary treatment at the Nine Springs Sewage Treatment Plant which is located on the southern edge of the City of Madison.

B. EXISTING PROBLEM

1. Background

On December 31, 1974, MMSD was awarded a Step 1 Grant (Grant No. C550826-01-02) from this Agency to prepare a facilities plan which would meet the requirements of Wisconsin Pollutant Discharge Permit No. WI-0025411. The facilities plan was to include documentation to determine the cost-effective construction of advanced waste treatment facilities and disposal of effluent, and handling and disposal of sludge from the treatment facilities.

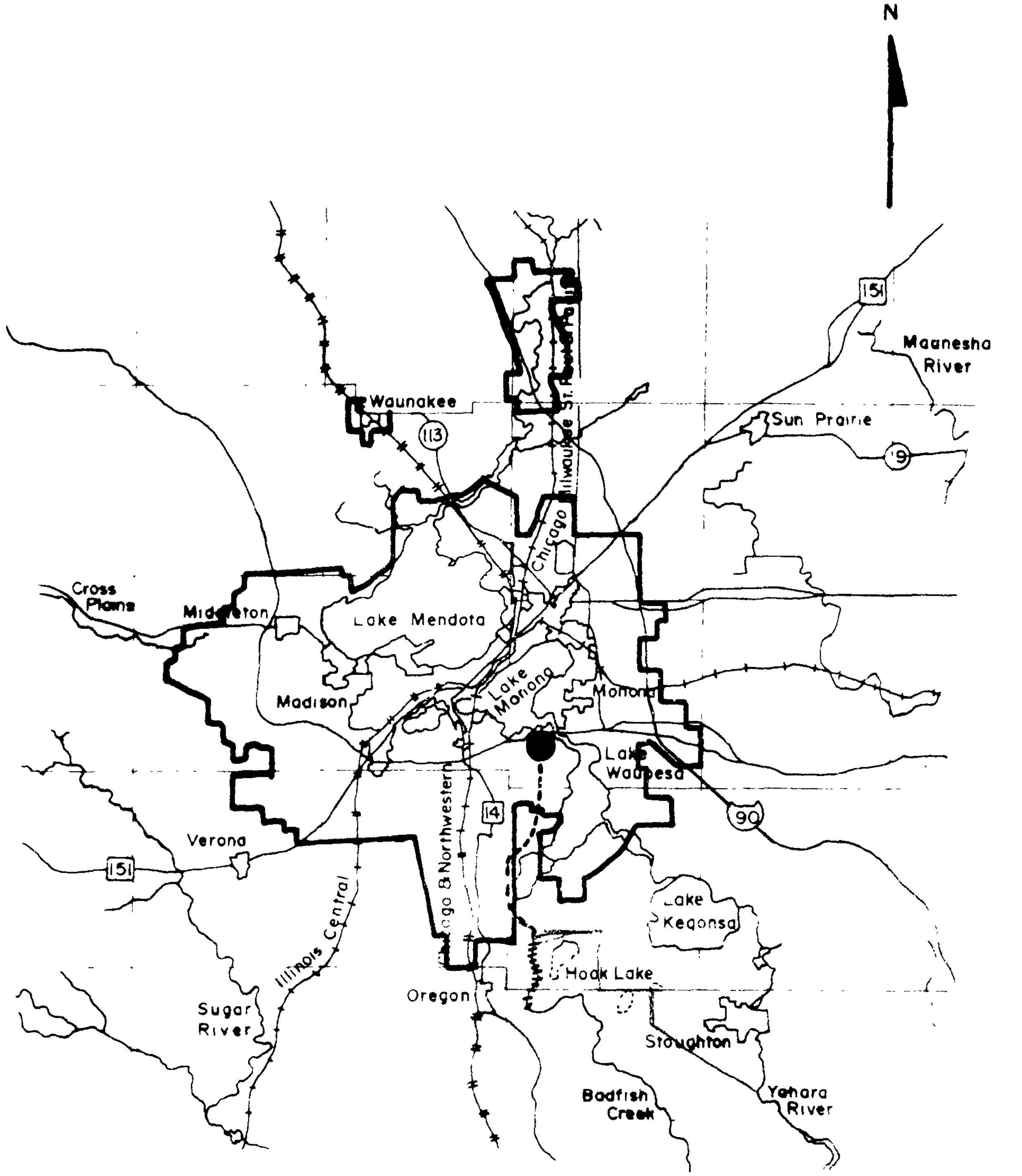
In July 1975, the facilities planning effort was segmented into two portions, 1) advanced waste treatment and effluent discharge (Grant No. C550826-01) and 2) solids handling and disposal (Grant No. C550826-02). This segmentation was done because of the need to expedite the solids handling portion of the study.

In October 1976, a draft EIS was filed with the Council on Environmental Quality on the solids handling and disposal portion of the facilities plan. A final EIS on the organic solids reuse plan was made available to the public in June 1977.

This draft EIS covers only the segment of MMSD's overall facilities planning effort concerned with advanced waste treatment and effluent discharge issues.

The EIS is presented in two volumes: Part I and Part II. Part I is comprised of USEPA's review and evaluation of MMSD's facilities plan and environmental assessment. Because MMSD's plan is so comprehensive, our review and evaluation of the plan in Part I is primarily issue-oriented: that is, it attempts to focus on only the issues most critical to deter-

FIGURE 1-1



● – NINE SPRINGS WASTEWATER TREATMENT PLANT

+++++++ – EFFLUENT DITCH

– – – – – EFFLUENT PIPELINE

MMSD FACILITIES PLAN

MMSD SERVICE AREA

Source - Volume I of MMSD's Facilities Plan

O'BRIEN & GERE ENGINEERS INC

mining the cost-effective advanced waste treatment and discharge alternatives. Some areas of potential impact may have been discussed only briefly, or not at all, because we felt that the subjects were not critical to the decison-making process. Part I also includes supplemental information which we felt was valuable in assessing the effects of the project and its alternatives.

In preparing this EIS we have attempted to avoid duplication of MMSD's facilities planning effort and, therefore, make many references to the numerous volumes of MMSD's facilities plan where more detailed information can be found.

Part II of this draft EIS is comprised of MMSD's summary facilities plan and environmental assessment. This volume is provided as supporting information for the draft EIS. Since Part II will not be revised by the applicant as part of the Final EIS, any comments related to the text of Part II will be responded to in the comment-response section of our Final EIS.

The firm, contracted by MMSD, who was responsible for preparation of the summary plan and environmental assessment of the plan attached as Part II of this EIS was O'Brien and Gere Engineers, Inc. of Syracuse, New York. This firm had major responsibility for coordination of the preparation of the facilities plan and worked in conjunction with MMSD, CH2MHill Engineers, of Corvallis, Oregon; the Dane County Regional Planning Commission; and Rock Valley Metropolitan Council who prepared portions of the plan.

2. History of Wastewater Treatment and Effluent Discharge in the Madison Area

Municipal treatment of wastewater in Madison was started in the late 1890's. The first treatment facility discharged to the Yahara River above Lake Monona. A succession of treatment plants, including the Burke treatment facility, were put into operation during the next twenty years, all of which also discharged above Lake Monona.

In 1928 the initial Nine Springs treatment facility was constructed to serve the southern and western portions of the city. The Nine Springs plant discharged to the Yahara River above Lake Waubesa. In 1930, the Madison Metropolitan Sewerage District was formed. The Nine Springs plant has been modified a number of times to increase the capacity of the plant and to upgrade the treatment processes, the most recent being the Fifth Addition was completed in late 1977.

The Burke plant, retired from full service in 1936, served as the treatment facility for the Truax Army Air Field from 1942 to 1946. The plant was used to handle bypassed flows during the construction of the eastside interceptor around Lake Monona from 1947 to 1950, at which time it was leased to the Oscar Meyer Company to be used for pretreatment of their meat packing wastes prior to discharge to the MMSD system.

Concern expressed by a number of groups over the years regarding the condition of the Madison Lakes indicated that some method of alleviating the pollutional loading to the lakes was desired. In 1943, the Wisoonsin legislature passed a bill which essentially prohibited discharge of the effluent from the Nine Springs plant to the Madison Lakes. Due to special restrictions concerning enforcement of the bill and various legal problems MMSD did not initiate plans to comply with the bill until the early in 1951, in response to Wisconsin Statute No. 144.05-1, which essentially prohibited future discharge of secondary effluent to the Madison Lakes, MMSD retained the firms of Greeley and Hanson and Mead and Hunt Engineers to study other alternative discharge points. The study recommended discharge to either the Yahara River below Lake Kegonsa or to Badfish Creek, which flows southerly and easterly to join the Yahara River below the City of Stoughton. An addendum to that report recommended discharging to Badfish Creek.

Subsequently, in 1956, a group of six Rock County farmers who owned land bordering Badfish Creek filed a suit (Stearns vs. Committee on Water Pollution) seeking to prevent diversion of the effluent. Their suit was not upheld by the courts.

In December 1958, the entire Nine Springs effluent flow was diverted via a force main and effluent ditch to Badfish Creek, greatly increasing the normal flow in what had once been a rather small stream. From 1958, until the present time, the discharge of secondary effluent to Badfish Creek has been a continuing source of controversy between MMSD and Rock County. In 1961, the fourth addition to the Nine Springs plant was constructed, providing further treatment capacity for a total of 30 MGD.

In 1967, during Intrastate Water Quality Standards Hearings, portions of Badfish Creek were listed as exceptions to the commonly accepted standards for water quality designed to protect fish and aquatic life, despite protests from Rock County.

In 1971, Rock County and the Rock Valley Metropolitan Council financed a study of Badfish Creek by Harza Engineering. The results of that study indicated a need for advanced levels of waste treatment. Attempts by Rock County during 1971 to have Badfish Creek reclassified to meet fish and aquatic life standards were successful, except that the portion in Dane County was given a variance.

In 1972, MMSD issued a contract for the design of expanded secondary treatment facilities (Fifth Addition) at the Nine Springs Treatment Plant.

In February 1973, the Rock County Board formally requested that an environmental impact statement be prepared for the Fifth Addition to the treatment plant.

In July 1974, MMSD proposed the establishment of a Facilities Planning Advisory Committee to guide the conduct of a Facilities Planning Study. The proposal included representatives from Rock County on the Committee.

In September 1974, this Agency determined that the construction of the Fifth Addition could proceed without a formal environmental impact statement, however, a formal EIS would be required at the completion of the facilities plan for proposals beyond the Fifth Addition.

At the same time, we funded the construction of the Fifth Addition to provide secondary treatment for a capacity of 57 MGD with the trickling filters in operation. If the trickling filters are abandoned, the secondary treatment capacity would be 50 MGD.

3. Issues Identified by USEPA and Others

There are several major issues which have been identified with respect to this project. Several concerns have been expressed by downstream users of Badfish Creek and the Yahara and Rock Rivers. These users, particularly Rock County residents feel that the wasteflow contributed by MMSD to Badfish Creek has seriously narrowed and will continue to affect the range of uses of the Creek and downstream waters. Opponents to MMSD discharge to Badfish Creek feel that MMSD's discharge to the Creek has seriously degraded and will continue to degrade the Creek as an aquatic habitat and for recreational use. They have expressed concern that diversion of MMSD's effluent to this stream has created flooding problems in the lands bordering the Creek. We examined these concerns in our evaluation of alternative receiving streams. The impacts vary according to the stream's characteristics.

In the facilities planning process additional issues were raised and evaluated. If MMSD continues diversion of effluent out of the Madison Lakes and the Upper Yahara River the potential exists for intensifying low flow problems in the Upper Yahara River by the year 2000 if mitigative measures are not implemented. Another concern which was raised was the appropriate baseline to use in evaluating the economic costs and environmental effects of the various alternatives considered in determining the most cost-effective proposal. Since MMSD's discharge pipeline to Badfish Creek already exists, some were concerned that there would be a natural economic and environmental bias toward continued discharge to Badfish Creek.

CHAPTER 2
EXISTING ENVIRONMENT WITHOUT THE PROPOSED ACTION

A. ATMOSPHERE (CLIMATE)

Section 2.02 of the environmental assessment presents an adequate summary of climatological conditions in the study area. More detailed information is available in Volume IV of MMSD's facilities plan.

B. LAND

1. Topography

Section 2.03 of the environmental assessment presents an adequate summary of the topographic setting of the study area. More detailed information is available in Volume IV of MMSD's facilities plan.

2. Geology

Section 2.04 of the environmental assessment adequately summarizes the geology of the study area. Additional information can be found in Volume IV of MMSD's facilities plan.

C. SOILS

Section 2.05 of the environmental assessment adequately summarizes soil formation in the study area. Additional information can be found in Volume IV of MMSD's facilities plan.

D. WATER RESOURCES

1. Water Quality and Quantity Management and Planning

Section 2 of the Summary Plan and Sections 1.04, 1.05 2.06 and 2.12 of the environmental assessment adequately summarize water quality and quantity management programs in the study area.

2. Groundwater Resources-Lower Rock River Basin

Section 6.01 of the summary facilities plan and Section 1.04 B and 2.06 B of the environmental assessment present an adequate summary of groundwater quality, quantity and uses in the Lower Rock River Basin. Additional information can be found in Volume IV, Appendix A, Section 2 of MMSD's facilities plan.

3. Surface Water Resources

a. Lower Rock River Basin

The summary plan and environmental assessment in Volume II of this EIS provide a generally adequate summary of the surface water resources of the Lower Rock River Basin. However, it is necessary to provide more detailed information as background for analysis of the project or indicate where the information can be found.

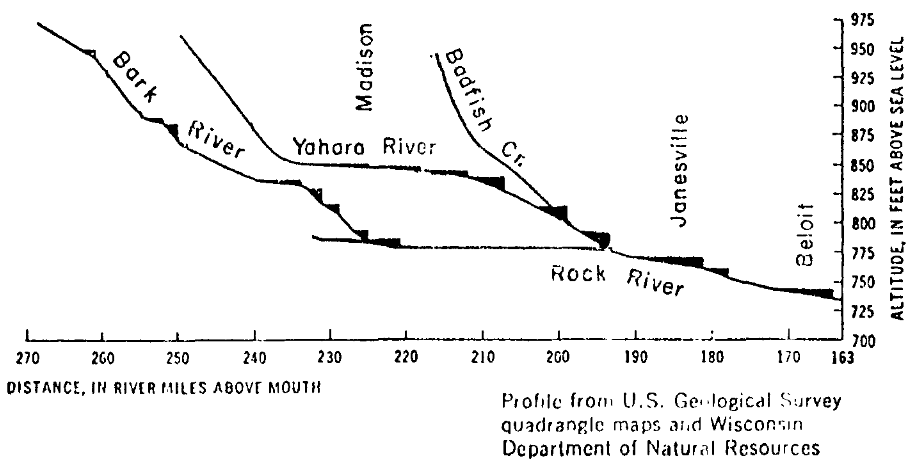
(1) Description of the Basin

Section 2.06 of the environmental assessment provides an adequate description of the streams in the Lower Rock River Basin.

(2) Water Quantity and Hydrology

Section 2.06 of the environmental assessment adequately summarizes surface water quantity and hydrology. Figure 2-1 shows the Lower Rock River Basin. To provide a more detailed picture of these characteristics the following information has been extracted from Volume IV, Appendix A and Volume V, Appendix H of the facilities plan.

> "The Rock River flows for approximately sixty miles in the Lower Rock River Basin, from north of the City of Fort Atkinson, through Lake Koshkonong and south to the Illinois border. Lake Koshkonong, originally a wide, marshy area, was formed by the construction of the Indianford dam in about 1850. The Rock River falls approximately 50 feet in the basin and this fall is largely absorbed by the Indianford, Janesville, Monterey and Blackhawk dams.
>
> "The Northwestern part of the basin is drained by the Yahara River and its tributaries. An outstanding feature of the Yahara is the series of five lakes: Mendota, Wingra, Monona, Waubesa and Kegonsa. These lakes were formed by glacial damming of the preglacial river valley. The Yahara River falls about 190 feet in its 60 miles of channel length. The headwaters above Lake Mendota absorb about 100 feet of this fall. The remaining 90 feet of fall is largely taken up by the outlet structures of Lakes Mendota, Waubesa and Kegonsa, as well as the four dams located at Stoughton, Dunkirk Stebbinsville and Fulton. A major tributary of the Yahara is the Badfish Creek, which falls about 145 feet in 15 miles of channel length. Above the Dane-Rock county line, the Badfish has been channelized to improve agricultural drainage and to accept the discharge of wastewater effluent. Below the county line, the Creek



MMSD FACILITIES PLAN

STREAM PROFILES

LOWER ROCK RIVER BASIN

FIGURE 2-1

SOURCE: MMSD FACILITIES PLAN
VOLUME IV, APPENDIX A

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largely remains in its original meandering condition. Since 1959, the Badfish Creek has received an average of about 41 cfs of treated wastewater effluent from the Madison Metropolitan Sewerage District via an effluent channel that joins the Badfish below the Village of Oregon.

"The Koshkonong Creek drains the eastern portion of Dane County. Flowing southeasterly from near the City of Sun Prairie to Lake Koshkonong, the Creek falls approximately 200 feet in 48 miles of length. Above the Village of Cambridge, the Creek has largely been straightened and improved to accomodate drainage. The stream bed is currently in poor condition due to the accumulation of brush and debris. The Creek has one impoundment, near the Village of Rockdale.

"The northeastern portion of the basin is drained by the Bark River and its tributaries. Included in this system are several small ponds and kettle lakes. The main channel of the Bark River falls about 188 feet over 44 miles of length.

"Turtle Creek drains the southeastern portion of the basin. Lake Delevan and Turtle Lake lie at the Creek's headwaters. Turtle Creek drops about 210 feet in 38 miles of channel length, from its headwaters to its confluence with the Rock River. The southwestern portion of the Lower Rock River Basin is drained by Marsh Creek, Bass Creek and several other small streams. Profiles of the major streams of the basin are presented in Figure 2-2.

"Flood flows are relatively low due to the small relief of the basin, as well as the storage capacity provided by the many lakes, reservoirs and wetlands. Flooding in headwater areas is generally limited to low-lying agricultural or undeveloped land adjoining waterways, although some springtime flooding of low-lying residences near the Madison Lakes and Lake Koshkonong does occur. Substantial flood potential does exist in the Cities of Janesville and Beloit where commercial and residential construction has taken place on the floodplain.

Refer to Section 6.03 of the summary plan for a discussion of base flow recession resulting from the diversion of wastewater out of the Upper Yahara River.

Additional information on water quantity and hydrology can be found in Volume IV, Appendices A and C and Volume V, Appendix H of the facilities plan.

(3) Water Uses

Section 2.06 of the environmental assessment adequately summarizes water uses. More detailed information can be found in Volume IV, Appendix A of MMSD's facilities plan.

(4) Effect of Diverting the Effluent from the Madison Nine Springs Sewage Treatment Plant

The Badfish Creek has received an average of 41 cfs of treated wastewater effluent since 1959 from the District's Nine Springs Sewage Treatment Plant. Previous to that it had been discharged to Nine Springs Creek and then into the Yahara River above Lakes Waubesa and Kegona. The effluent from Nine Springs STP flows southward through five miles of 54-inch pipeline and approximately four miles of open ditch and enters Badfish Creek below Oregon. Badfish Creek also receives the effluent from the Oregon Sewage Treatment Plant. Mackenthun (1960) studied pre-and post-diversion conditions in the Badfish Creek, Yahara River and Rock River to determine the chemical and biological effects of diverting MMSD's effluent. The following paragraphs summarize his findings.

(a) Methods

Three stations were sampled on the Badfish Creek. Station 1 was approximately one mile below the confluence with the diversion ditch. Station 4 is approximately four miles downstream from Station 1 and is also located in the channelized portion of the creek and at the point of a U.S.G.S. gauging station. Station 8 is downstream and approximately 1-1/2 miles above the confluence with the Yahara River.

Three stations were also sampled on the Yahara River, Station 10 above the confluence with the Badfish Creek and Stations 9 and 14 below this confluence. These stations are located in the approximate 6.4 mile reach of the Yahara between the confluence of the Yahara with Badfish Creek and with the Rock River.

Three stations were also sampled on the Rock River. Station 15 is approximately 2 miles upstream of the confluence of the Yahara and Rock Rivers and Stations 16 and 17 are located 6 and 10 miles downstream of the confluence.

Water samples for chemical and phytoplankton determinations were taken bi-weekly for a year prior to diversion and a similar period subsequent to diversion. Bottom fauna were collected and examined at several places on Badfish Creek. These collections were made twice prior to diversion and twice subsequent to diversion.

(b) Physical Changes

The following has been excerpted from the portion of the Mackenthun study which describes the physical changes in the Badfish Creek resulting from the improvements and from diversion of MMSD's effluent:

> "As the effluent leaves the 54" pipeline, it enters a rather straight ditch with steep banks. The first approximately one-half mile of this ditch often carries a blanket of detergent foam. Approximately one mile farther down stream, the banks of the ditch become less steep, and as early as one year following the onset of diversion, there was some evidence of vegetation encroachment, principally round-stemmed bullrush. Badfish Creek itself was dredged to a bottom width of 16 feet for approximately four miles, and a bottom width of 20 feet for the remaining six miles of improved stream. This made a tremendous change as indicated by the "before" and "after" at Station 1 which is located a short distance down stream from the ditch entrance into Badfish Creek. Along with the change in flow produced by the introduction of approximately 20 million gallons per day of effluent. Prior to diversion, Badfish Creek at about its mid point between its orgin and confluence with the Yahara River had an average flow of 9.6 c.f.s. for the 2-1/2 years in which records were kept. Following diversion, the flow averaged 43 c.f.s. for the summer portion of the period of study. In the unimproved portion of Badfish Creek there was little gross physical change noted as a result of diversion.
>
> "Badfish Creek originally contained many riffle areas with a bottom composed principally of small rock and gravel. The bottom was of course, altered in the improved section, yet remains a coarse gravel over much of the area.
>
> "Concurrent with the discharge of considerable quantities of suspended solids, a sludge deposit has built up over most of the upstream portions of Badfish Creek. In some areas, especially in small pockets along the side of the stream, this deposit approaches six to ten inches in depth. In most of the upstream region, as well as the ditch itself, the sludge is of sufficient thickness to produce a suitable habitat for a bountiful population of midge larvae.

(c) Chemical and Bacteriological Changes

Related to the change in water chemistry of Badfish Creek resulting from diversion the Mackenthun, study report concluded that:

> "The water chemistry of Badfish Creek especially responded to diversion with substantial increase organic nitrogen (influenced principally by ammonia nitrogen), phosphorus, and B.O.D. The dissolved oxygen was reduced to a critical level many times throughout the summer, and a D.O. deficit of 700 pounds per day existed at Station 4 during this period." (Station 4 is in the downstream reaches of the creek but upstream from the confluence of the Badfish and the Yahara River.)

Table 2-1 summarizes the biological and chemical data.

(cl) Organic Nitrogen

The resluts of the study showed that both in 1956 and 1959 there was a progressive decrease in the concentration of organic nitrogen as one moved downstream. The samples prior to diversion showed some effect from the effluent of the Oregon Sewage Treatment Plant. The samples after diversion show the combined effect of the effluents from the Oregon STP and MMSD's Nine Springs STP. There appeared to be no statistical difference between the samples from the Yahara River stations above and below the confluence of the Yahara with the Badfish or between the samples collected in 1956 and 1959. In the Rock River there was also no statistical difference between samples from the stations on that river or between 1956 or 1959 samples.

(c2) Inorganic Nitrogen

The 1956 samples prior to diversion, showed the effect of the Oregon STP. The samples taken in 1959 subsequent to diversion showed the dominant influence of MMSD's effluent discharge. The 1959 samples indicated a five-fold increase in pounds per day over the 1956 data. There was a decrease in concentration as one moved downstream. In 1956 there were no statistical differences between the Yahara River samples above and below the confluence with the Badfish. However, in 1959 there was a significant increase in inorganic nitrogen at Stations 9 and 14 below the confluence as compared to Station 10 above the confluence thus demonstrating the heavy concentration of inorganic nitrogen being carried by the Badfish. This huge increase in inorganic nitrogen is due primarily to an increase in ammonia nitrogen. There was no statistical difference between the mean data for the three stations on the Rock River in 1956 or between the mean data for the three stations in 1959. These results showed that the effect of MMSD's effluent discharge with respect to inorganic nitrogen extended into the Yahara River but not into the Rock River.

Table 2-1
Summary of Biological and Chemical Data Before and After Diversion on Badfish Creek, Yahara River, Rock River - Based Upon 26 Bi-weekly Dates Extending From June 6, 1956 to May 22, 1957, and March 4, 1959 to February 17, 1960

	Sta.	Range		Pounds Per Day[1] Range		Mean	
		1956	1959	1956	1959	1956	1959
Phytoplankton[2]	1	0.12-40.93	0.37-10.16				
	4	1.09-15.43	0.55-12.45	56-791	247-1,455	259	622
	8	1.35-16.74	0.22-13.99				
	10	0.04-37.43	0.11-56.87				
	9	0.33-24.38	0.39-30.71				
	14	0.16-37.38	0.15-52.53				
	15	0.58-62.19	0.53-57.55				
	16	0.55-56.51	1.03-62.20				
	17	1.06-62.24	0.23-53.67				
Organic N.[2]	1	0.33-2.20	1.33-11.74				
	4	0.27-2.00	0.93-9.50	13-71	206-447	30	286
	8	0.21-2.30	1.03-7.10				
	10	0.60-4.34	0.00-2.44				
	9	0.64-2.32	0.94-3.34				
	14	0.60-2.70	0.60-2.65				
	15	0.90-3.71	0.94-3.54				
	16	0.88-3.51	0.74-3.34				
	17	0.94-3.31	0.84-3.24				
Inorganic N.[2]	1	1.98-5.53	13.4-21.1				
	4	1.73-3.64	10.0-18.7	89-143	2,171-4,246	110	3,153
	8	1.38-4.49	7.2-17.6				
	10	0.09-1.24	0.09-2.82				
	9	0.10-2.18	1.09-11.31				
	14	0.10-1.51	0.80-4.64				
	15	0.09-0.68	0.10-3.32				
	16	0.09-0.91	0.15-3.10				
	17	0.05-1.13	0.19-3.09				
Soluble P.[2]	1	0.30-1.56	5.5-12.0				
	4	0.10-0.30	4.4-7.3	7-12	996-1,701	9	1,351
	8	0.01-0.12	3.0-8.4				
	10	0.46-1.30	0.23-1.5				
	9	0.16-1.30	0.56-6.4				
	14	0.40-1.28	0.58-2.6				
	15	0.01-0.19	0.01-0.68				
	16	0.01-0.41	0.15-0.94				
	17	0.02-0.44	0.13-1.40				
B.O.D.[2]	1	1.8-7.7	4.1-39.4				
	4	0.8-5.4	3.1-55.8	30-113	755-2,333	75	1,602
	8	0.6-8.8	3.3-38.4				
	10	1.3-14.5	1.5-7.70				
	9	1.8-15.7	2.5-19.7				
	14	1.5-14.3	2.4-15.4				
	15	3.5-17.1	2.2-15.3				
	16	2.7-14.3	2.1-12.9				
	17	3.0-15.4	2.4-10.2				
D.O.[2]	1	3.1-13.4	0.1-8.9				
	4	7.8-15.9	1.7-10.7	368-636	413-1,749	475	904
	8	6.6-16.7	2.2-11.1				
	10	4.2-21.6	5.9-17.5				
	9	8.9-19.3	3.9-16.7				
	14	5.6-15.4	2.9-15.7				
	15	4.4-20.9	3.0-25.8				
	16	6.6-18.3	6.4-22.0				
	17	5.3-18.1	6.1-20.5				
pH	1	7.5-8.2	7.4-8.1				
	4	7.7-8.6	7.5-8.2				
	8	7.7-8.8	7.7-8.1				
	10	8.0-9.9	7.7-9.2				
	9	8.2-9.8	7.0-8.9				
	14	8.1-9.6	7.7-8.9				
	15	8.3-9.2	7.7-9.1				
	16	7.8-9.7	7.6-9.3				
	17	7.9-9.4	7.8-9.2				
M.P.N. (x 10^3)	1	7-540	3.3-790				
	4	0.5-160	4.9-350				
	8	0.4-240	0.8-1,200				
	10	0.02-18	0.2-49				
	9	0.08-35	0.8-130				
	14	0.05-54	1.3-430				
	15	0.2-35	0.5-210				
	16	0.2-17	0.3-170				
	17	0.2-54	0.3-160				

[1]Pounds of material per day on 9 bi-weekly paired dates (June 1 - October 1) for Station 4. Flow in c.f.s. in 1956 ranged from 8.0 - 10.0 with a mean of 8.7; in 1959 the flow in c.f.s. ranged from 40.0 - 48.0 with a mean of 43.0.

[2]Parts per million.

Source: Mackenthun, 1960

(c3) Soluble Phosphorus

Prior to diversion, Badfish Creek clearly showed the effect of the Oregon Sewage Treatment Plant through a high soluble phosphorus concentration at Station 1 with decreasing amounts downstream at Stations 4 and 8. Following diversion, Badfish Creek showed an increase in the soluble phosphorus content in the neighborhood of 30 times prediversion levels. The Yahara River samples were all high in soluble phosphorus in 1956 which most likely was being discharged from Lakes Waubesa and Kegonsa. There was no statistical difference between any of the Yahara River stations in 1956. In 1959, Station 10 above the confluence with Badfish Creek had about the same concentration of soluble phosphorus as in 1956. However, the concentration at Stations 9 and 14 below the confluence showed about a two-fold increase as compared to Station 10. The diversion of MMSD's effluent exerted no change in soluble phosphorus concentration in the Rock River.

(c4) Biological Oxygen Demand (B.O.D.) and Dissolved Oxygen (D.O.)

The Mackenthun study showed that diversion had a strong effect on B.O.D. and D.O. levels in Badfish Creek. In the summer portion of the sampling period subsequent to diversion there was a deficit of 700 pounds of D.O. per day at Station 4 as compared to a level of D.O. of 400 pounds per day higher than the B.O.D. for the same period prior to diversion. Subsequent to diversion, summertime D.O. levels in Badfish Creek frequently fell below 3 p.p.m. or less which falls below conditions critical for the survival of fish and other desirable form of aquatic life. Data presented in the report indicated that D.O. levels prior to diversion ranged from 3.1-13.4 p.p.m. at Station 1, from 7.8-15.9 p.p.m. at Station 4 and from 6.6-16.7 p.p.m. at Station 8. The B.O.D.- D.O. relationship in the Yahara and Rock Rivers did not appear to be affected by the past diversion B.O.D.-D.O. relationship change in the Badfish Creek.

(c5) Coliform Organisms

Related to coliform organisms the study stated that:

> "The most probable number (MPN) of coliform organisms per 100 ml. was quite variable throughout the course of the study. As pointed out earlier, the effluent from the Oregon Sewage Treatment Plant was not chlorinated and did show an effect upon Badfish Creek prior to diversion with an above-normal concentration of coliform organisms. Following diversion the MPN determinations for Badfish Creek were higher than those recorded for 1956. The influence of the Nine-Springs effluent was perceptible also in the Yahara River. The MPN determinations for the Rock River ranged higher at all three stations than similar samples in 1956. This phenomenon was undoubtedly due to factors other than those of diversion."

(d) Biological aspects

The study concluded that:

> "Phytoplankton populations were of substantially the same concentration between the three stations on a given stream, and between the two periods of study for similar stations on the same stream, but were greater in the Yahara River than in Badfish Creek, and greater in the Rock River than in the Yahara River. There was indication of a population depression following diversion at the upper stations on Badfish Creek, and a difference in genera encountered between the pre- and post-diversion samples.
>
> "Submerged aquatic vegetation was abundant prior to diversion, and already in 1959 had become abundant in the dredged portion of the creek. Perhaps it is yet too early to judge, but the submerged plants do not now present a problem. Long streamers of filamentous algae were attached to plants and bottom materials at numerous locations. A blanket of Oscillatoria covered much of the bottom of the creek.
>
> "A study of bottom organisms indicated severe stream degradation following diversion. Stream biota changed from a balanced population containing several species and many intolerant organisms, prior to diversion, to a population containing few species and only very tolerant sludge worms and midge larvae following diversion.
>
> "The benthos in Badfish Creek exhibited a much greater response than the phytoplankton to the addition of nutrients, suspended solids, and B.O.D. contained in the effluent of the Nine-Springs Sewage Treatment Plant."

(5) Base Flow Recession and Other Impacts Resulting from Wastewater Diversion

Additional discussion of the impact of diversion of the effluent from the Nine-Springs Sewage Treatment Plant can be found on pages 6-5 and 6-6 of the summary plan and includes consideration of base flow recession resulting from diversion.

(6) Present Water Quality

(a) Point and Non-point Sources of Pollution

Section 3 of the summary plan and Sections 1.04 and 2.06 of the environmental assessment adequately discuss point and non-point pollution sources. More detailed information may be found in Volume IV, Appendix A, Section 2.06 and Appendix B, Section 6.

(b) Water Quality

Section 2.06 of the environmental assessment discusses water quality in the basin very generally but does not present specific information. As indicated in that section, sampling and analysis of these streams are conducted by different agencies. MMSD currently collects samples on a bi-weekly basis from twelve monitoring stations on the Yahara River, Badfish Creek and the Rock River. The Wisconsin Department of Natural Resources (WDNR) collects additional samples on a monthly basis. Also, a special water quality monitoring program was conducted during the course of MMSD's facilities planning study. Volume IV, Appendices A and B present detailed water quality information resulting from these water quality investigations. Relevant portions of that information are presented here in summary form.

(b1) WDNR and MMSD Monitoring of the Badfish Creek, Yahara River, and Rock River

Figure 2-2 shows the Wisconsin DNR stations monitored monthly and ten MMSD stations monitored bi-weekly. Figure 2-3 which is based on the collected data shows the degree to which the water quality at the WDNR and MMSD monitoring stations has been found to comply with 1983 water quality goals for dissolved oxygen and ammonia nitrogen, and for protection of fish and aquatic life. Water quality at only four of the twelve stations consistently meets the dissolved oxygen requirement, while ammonia nitrogen is not consistently below the maximum limit at any station. A significant pollution control effort is required to enable these basin streams to meet 1983 water quality goals.

(b2) Results of Receiving Water Quality Investigations Conducted as Part of MMSD's Facilities Study

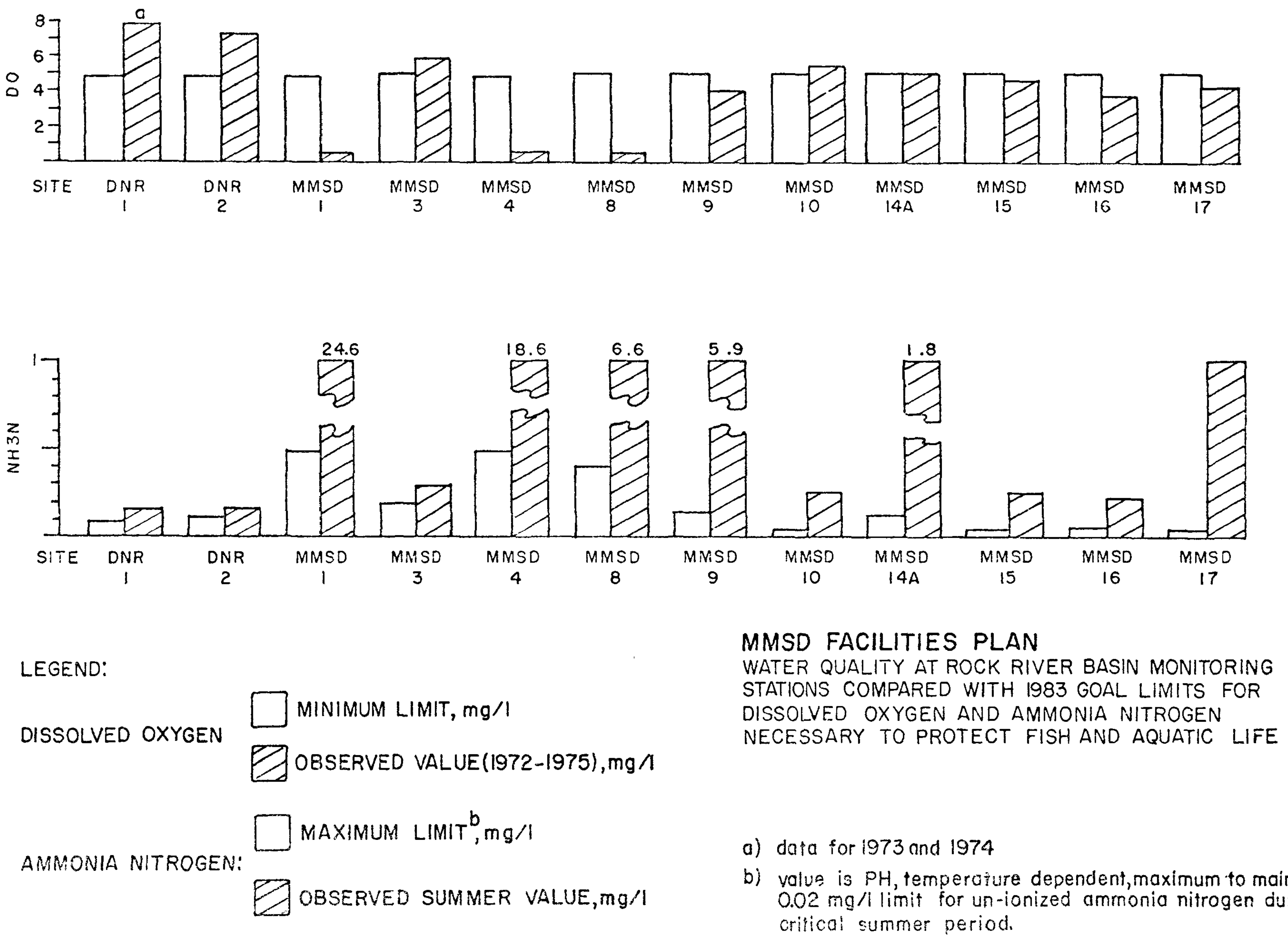
Volume IV, Appendix B of MMSD's facilities plan presents the results of special stream investigations. This work was conducted to aid in the development of environmental inventory data, to collect additional data in a manner appropriate for the development of mathematical water quality predictive models, and to otherwise aid in the evaluation of alternative discharge sites. The following data collection programs were conducted:

- monitoring of five sites on the Badfish Creek main stem, one site on the Rutland Branch, and two sites on the Yahara River, at five week intervals throughout the spring, summer, and fall of 1975;

- water quality surveys of the Wisconsin River between Prairie du Sac and Spring Green in August and October, 1975;

FIGURE 2-3

SOURCE: MMSD FACILITIES PLAN
VOLUME IV, APPENDIX A



MMSD FACILITIES PLAN

WATER QUALITY AT ROCK RIVER BASIN MONITORING STATIONS COMPARED WITH 1983 GOAL LIMITS FOR DISSOLVED OXYGEN AND AMMONIA NITROGEN NECESSARY TO PROTECT FISH AND AQUATIC LIFE

a) data for 1973 and 1974

b) value is PH, temperature dependent, maximum to maintain 0.02 mg/l limit for un-ionized ammonia nitrogen during critical summer period.

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- intensive surveys of the Badfish Creek and Yahara River during the summer of 1975;

- water quality surveys and algal bio-assay investigations of Lakes Waubesa and Kegonsa during the summer of 1975;

- non-point source pollution investigations of rural runoff to Rutland Branch and Spring Creek, tributaries of the Badfish Creek, during spring thaw and summer rain events of 1975; and
- sediment oxygen demand surveys of the Badfish Creek, Yahara River, and Wisconsin River conducted in the fall of 1975.

The following is a discussion of the results of these six programs

(b3) Continuous Monitoring Program, Badfish Creek Main Stem, Rutland Branch and Yahara River

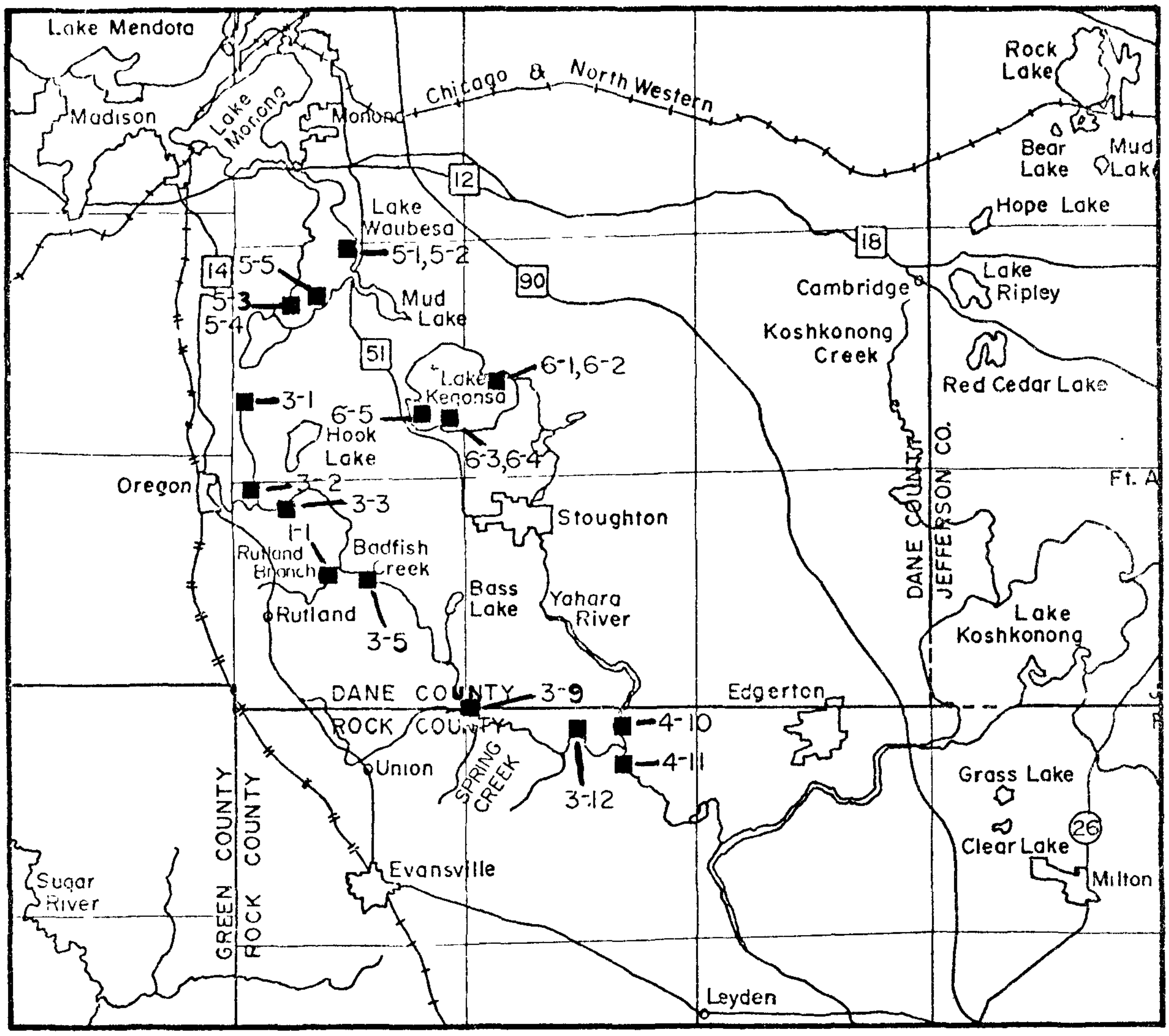
The eight sites monitored were chosen for purposes of assessing the impact of the existing MMSD discharge in the Badfish Creek, to aid in determing those areas of most severely depressed oxygen, and the extent to which the stream recovers from the current discharge due to natural processes. The sites monitored are Stations 1-1, 3-1, 3-3, 3-5, 3-9, 3-12, 4-10, and 4-11 shown on Figure 2-4.

(b3a) Organic Loading

The results of the continuous monitoring program indicate that the existing MMSD discharge greatly increases the organic loading to the Badfish Creek and the Yahara River, BOD28 values in the Badfish Creek Main Stem being 10 to 45 times those of the Rutland Branch and Yahara River B.O.D.28 values increasing 1.5 to 3 times below its confluence with the Badfish Creek. Similar trends were observed for TKN. A less pronounced impact was observed for VSS, where values were found to be much higher than "background levels" in the upper reaches of the Badfish Creek, but, due to sedimentation and natural breakdown, began to approach values similar to the Yahara River downstream. A downstream decrease in B.O.D. and TKN was also observed in the Badfish Creek, due to natural assimilation of these materials, and to dilution.

(b3b) Dissolved Oxygen Profiles

The organic loading to the Badfish Creek was found to create a critical dissolved oxygen deficit near Station 3-3, in the upstream reach of the Badfish Creek, such that even the variance D.O. standard was violated at times. Below Station 3-3, sufficient recovery was observed such that D.O. levels were near 5 mg/l during the critical summer period.



MMSD FACILITIES PLAN

SITES MONITORED

BADFISH CREEK, RUTLAND BRANCH,

YAHARA RIVER, LAKES WAUBESA AND KESONGA

FIGURE 2-4

SOURCE: MMSD FACILITIES PLAN
VOLUME IV, APPENDIX B

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Diurnal D.O. profiles often display the results of photosynthetic activity, with elevated D.O. levels during daylight hours, and depressed D.O. levels at night. Critical levels are often observed just before dawn. During these studies, these effects were not found to be significant. However, it should be pointed out that these data were collected during a relatively high water year, and that a much more significant diurnal DO profile could be expected during conditions of low flow such as may occur for seven days once in ten years. During such a condition, for example, the algal concentrations in the Yahara River below the Madison Lakes may combine with greatly reduced stream reaeration to produce a substantial diurnal D.O. fluctuation.

(b3c) Bacterial Contamination

Fecal coliform, an indicator of bacterial contamination of surface waters, was found in concentrations exceeding the recreational use standard at all sites. The Rutland Branch Station (1-1), the effluent ditch Station (3-1), and the upstream Yahara River Station (4-10) exceeded the 200 coliform/100 ml standard in two of the eight samples collected, while all other sites exceeded the limit in four or more samples. It should be noted that the high average fecal coliform concentration at Station 3-1 is biased by the extremely high 9400 coliform/100 ml value observed on May 21, 1975, and that in general the degree of disinfection provided by the MMSD was found to be food. Downstream contamination may therefore be due primarily to other sources.

(b3d) Inorganic Contaminants

The overall impact on the receiving streams of the existing MMSD discharge, with respect to inorganic contaminants, is summarized in Table 2-2. It can be seen that recommended stream standards were not violated with respect to ten of the parameters measured. Chlorides, chromium and nickel were found to be higher than recommended limits downstream of the MMSD discharge whereas background levels observed at Stations 1-1 and 4-10 were found to meet the recommended criteria. Aluminum, copper, and mercury concentrations were found to exceed recommended limits at Stations 1-1 and 4-10, and concentrations of these parameters were not found to be significantly higher at those sites effected by the MMSD discharge. Iron, ammonia nitrogen, total dissolved solids, and zinc concentrations were found to exceed recommended limits for beneficial use at all monitoring sites, and a significant increase over background levels was observed at those sites affected by the MMSD discharge.

Table 2-2

Impact Of Inorganic Contaminants Present In Existing MMSD Wastewater On Receiving Water Quality For Beneficial Use

Stream Standard Not Violated	Stream Standard Violated, Background Levels Acceptable	Stream Standard Violated, Background Violates, Increase Due to Discharge Not Significant	Stream Standard Violated, Background Violates, Increase Due to Discharge Significant
Boron	Chlorides	Aluminum	Iron
Barium	Chromium	Copper	Ammonia Nitrogen
Cadmium			
Cobalt	Nickel	Mercury	Total Dissolved Solids
Potassium			Zinc
Manganese			
Molybdemum			
Sodium			
Nitrate Nitrogen*			
Lead			

* Note: Nitrate Nitrogen may violate drinking water standard with nitrification.

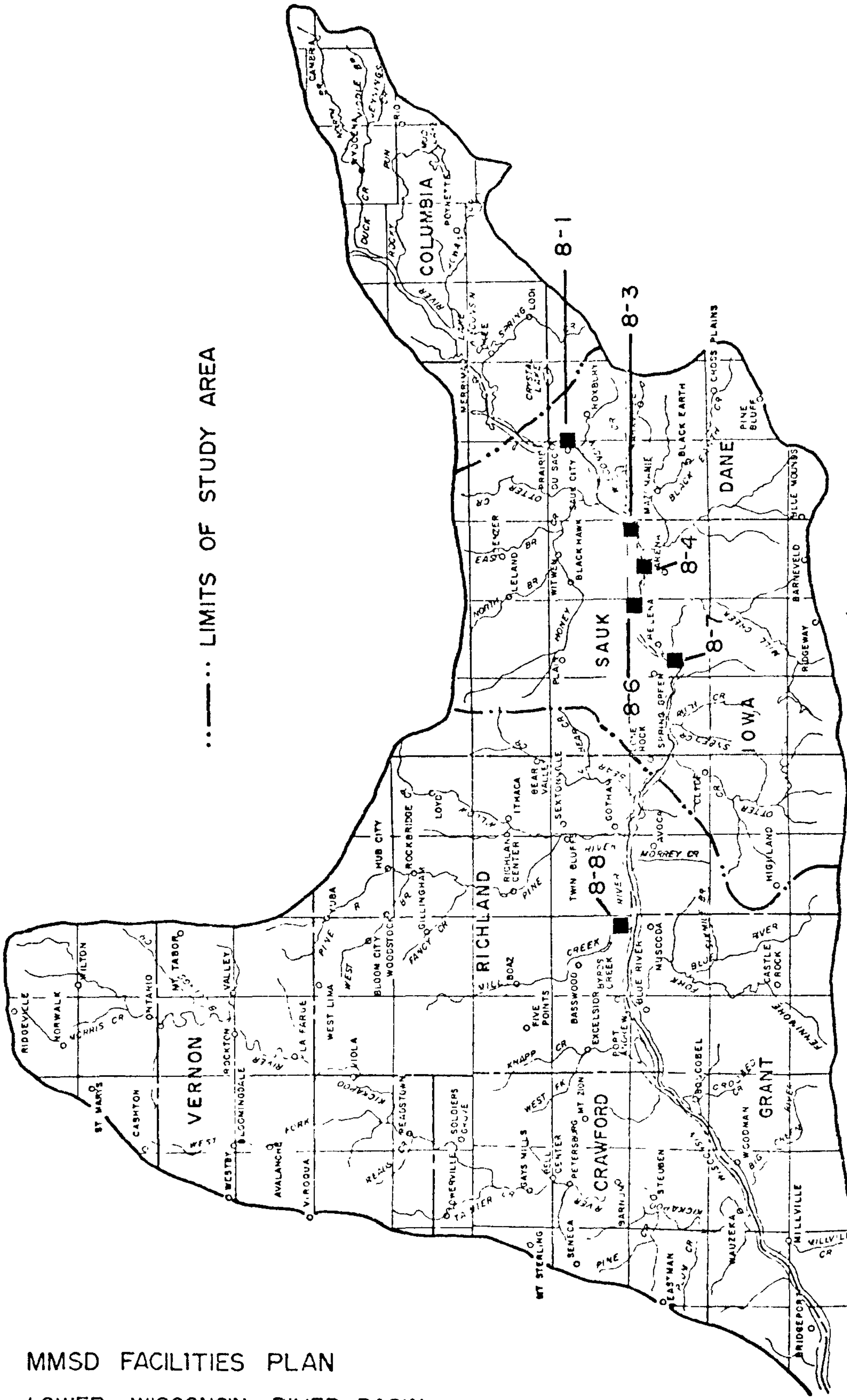
Source: Volume IV, Appendix B of MMSD's Facilities Plan.

(b4) Wisconsin River Surveys

The sites monitored on the Wisconsin River as part of this program are shown in Figure 2-6. The relatively low values observed for organic materials indicate that, in the study area, the river has generally recovered from upstream discharges. A low D.O. value was noted, however, on August 22, 1975, at Station 8-1, and may result from organic decay in Lake Wisconsin, an impoundment of the Wisconsin River above Prairie du Sac. Values for arsenic, iron, and mercury were also found to be higher than those recommended for the propagation of fish and aquatic life.

(b5) Intensive Stream Surveys, Badfish Creek and Yahara River

In order to provide appropriate data to develop and verify water quality predictive models for the various potential receiving streams for Nine Springs STP effluent, intensive surveys were conducted on Badfish Creek and the Yahara River during the summer of 1975.



MMSD FACILITIES PLAN

LOWER WISCONSIN RIVER BASIN

SITES MONITORED

FIGURE 2-5

This work involved the collection of samples at a larger number of locations for each stream than monitored during the continuous program; dyetracer studies to estimate the time-of-travel for each stream, and to serve as a check on the hydraulic predictions of the water quality model; and sampling of the Badfish Creek according to estimated time of travel. Emphasis was placed on the collection of data for biodegradable parameters. The results of the study indicate that degradation of the oxygen consuming materials present in the MMSD discharge is evident from the Badfish Creek data. No downstream decreases in biodegradable constituents can be noted from the Yahara River data, suggesting that degradation of the materials present in the outflow of Lake Kegonsa is balanced by inputs due to point sources, non-point sources, and primary production. Additional information related to these surveys can be found in Volume V, Appendix I of MMSD's facilities plan. Appendix I discusses how the results of this study and others were used to develop and verify the water quality predictive models for potential receiving streams.

(b6) Water Quality and Algal Bio-assay Studies, Lakes Waubesa and Kegonsa

In order to assess the present trophic status of Lakes Waubesa and Kegonsa, and to aid in the evaluation of these lakes as potential discharge sites for MMSD's effluent discharge, two data collection programs were conducted in the summer of 1975.

The first program involved the collection of water samples from various locations and depths in both lakes. This program also involved the enumeration of algal species present in the photic zone of each lake throughout the sampling period. The data collected in this study were compared with data collected previously by others. This was done to determine any changes in water quality of the lakes since the diversion of MMSD effluent from Lake Waubesa in 1959.

The second program consisted of algal bio-assay experiments to assess nutrient limitations. The objective of this study was to determine the probable impact of treated wastewater discharge on the rate of algal growth in the lakes.

Volume V, Appendix F of MMSD's facilities plan discusses the data collected in these programs and also examines historical data on the Madison lakes. The following discussion has been extracted from Appendix F, pages 3-128 and 3-129.

> "The examination of historical data as well as results from this study indicate that Lakes Mendota and Monona are phosphorus limited during the summer and the total phosphorus levels in Lakes Waubesa and Kegonsa have declined markedly since the diversion of MMSD wastewater to Badfish Creek in 1958. Although available data

are insufficient to establish long term changes in other chemical parameters, recent information indicates that Lakes Waubesa and Kegonsa have many characteristics common to other highly eutrophic lakes such as high chlorophyll concentrations, high B.O.D. levels, and low Secchi depths. However the results of this study and historical data suggests that compositions of algal species has become more favorable in the last two decades with a resultant slight improvement in asthetic (sic) quality of the lower lakes. Despite high algal and major nutrient levels in the lower lakes, bio-assays conducted for this study indicate that the addition of MMSD effluent would cause significantly increased plankton production in the lower lakes. With the upper lakes, the discharge of MMSD wastewater containing some phosphorus would cause an increase of plankton production, especially during the summer when the upper lakes become phosphorus limited. Thus it can be concluded that the discharge of treated MMSD effluent to the lakes would cause degradation of water quality in the lakes.

(b7) Nonpoint Source Water Pollution Investigations-

The results of these investigations are adequately discussed in the summary plan pages 3-2-3-18.

(b8) Sediment Oxygen Demand Measurements, Badfish Creek, Yahara River, Wisconsin River-

The results of these investigations indicated a high existing sediment oxygen demand in Badfish Creek, a relatively high sediment oxygen demand in the Yahara River and insignificant sediment oxygen demand in the lower Wisconsin River in the study area. These results were incorporated into the water quality predictive modeling portion of MMSD's facilities planning study.

b. Lower Wisconsin River Basin

(1) Description of the Basin

Section 2.06 C of the environmental assessment provides an adequate summary description of the basin. More detailed information can be found in Volume IV, Appendix A of the facilities plan.

(2) Water Quantity and Hydrology

Section 2.06 C of the environmental assessment adequately summarizes this subject. More detailed information can be found in Volume IV, Appendix A and Volume V, Appendix H of the facilities plan.

(3) Water Uses

Section 2.06 of the environmental assessment adequately discusses surface water uses in the Lower Wisconsin River Basin. More detailed information can be found in Volume IV, Appendix A of MMSD's facilities plan.

(4) Water Quality

(a) Point and Nonpoint Sources of Pollution

Section 3 of the Summary Plan and Sections 1.04 and 2.06 C of the evironmental assessment adequately discuss point and nonpoint pollution sources. More detailed information may be found in Volume IV, Appendix A, Section 2.06 of the facilities plan.

(b) Water Quality Conditions

Section 2.06 C of the environmental assessment and the previous section of the EIS on the special water quality investigations carried out under MMSD's facilities planning study adequately summarize present water quality conditions in the Lower Wisconsin River Basin.

c. Sugar River Basin

(1) Description of the Basin

Section 2.06 D of the environmental assessment provides an adequate summary description of the basin. More detailed information can be found in Volume IV, Appendix A of the facilities plan.

(2) Water Quantity and Hydrology

Section 2.06 D of the environmental assessment adequately summarizes this subject. More detailed information can be found in Volume IV, Appendix A of MMSD's facilities plan.

(3) Water Uses

Section 2.06 D of the environmental assessment adequately considers water uses in this basin. More detailed information can be found in Volume IV, Appendix A of MMSD's facilities plan.

(4) Water Quality

(a) Point and Nonpoint Sources of Pollution

Section 3 of the Summary Plan and Sections 1.04 and 2.06 D of the environmental assessment present adequate information on this subject.

More detailed information is included in Volume IV, Appendix A of the facilities plan.

(b) Water Quality Conditions

Section 2.06 D of the environmental assessment adequately summarizes water quality conditions in the Sugar River Basin. Refer to Volume IV, Appendix A of the facilities plan for more detailed information.

E. Biological Resources

1. Habitat

Section 2.07 of the environmental assessment summarizes the native vegetation to be found in the study area, both terrestrial and aquatic. Some supplemental discussion is required.

One plant species which possibly occurs within the study area has been included as a proposed endangered species on the proposed list of "Endangered and Threatened Plant Species of the United States" published in the Federal Register on June 16, 1976. Lespedeza leptostachya (bushclover) is expected to occur on dry prairies in the study area. Since this project has been planned only on existing rights-of-way which have been previously disturbed it is unlikely that any alternative would affect this plant species.

Related to aquatic biology, Section 2.07 I of the environmental assessment indicates that a sampling program to identify the algae species of Badfish Creek was conducted. The program referred to was a survey of fish and algae of the Badfish Creek mainstem and Rutland Branch and Yahara River conducted in 1975 by John Magnuson and Gary Herbst from the University of Wisconsin. From their survey of fish and algae they concluded that:

1) in relation to Badfish Creek

a) Badfish Creek is most severely polluted upstream of

b) limited recovery occurs in the lower regions of the stream,

c) water quality of Badfish Creek is inferior to both the Rutland Branch and the Yahara River;

2) the fish found in the Yahara River appear unaffected by Badfish Creek;

3) diatom species abundance and diversity in the Yahara River is reduced downstream of the mouth of Badfish Creek indicating therefore, that the algal flora of the Yahara River is influenced by the Badfish Creek);

4) the Rutland Branch (of Badfish Creek) is a pristine stream;

5) further detailed investigations of the fish fauna are warrentred.

Their report also described the impact of sewage diversion on the Badfish Creek fish fauna. The report states:

"The response of the fish commmunity to sewage effluent in Badfish Creek has been complex. The upstream areas of the stream previously supported a fish community including brown trout, darters, dace, stonerollers, and suckers (Dohrman, 1946). All but the suckers (Catostomus commersoni) have been eliminated, indicating severe degradation. Darters, dace and stonerollers are known to be sensitive to organic pollution (Katz and Gaufin, 1952). In contrast, the lower regions of Badfish Creek (downstream from Cooksville) did not previously support trout, though populations of darters, stonerollers, and dace were present. In addition, carp were reported from the downstream regions, while suckers were the most common fish species (Dohrman, 1946). Darters, stonerollers, and dace have also been eliminated from lower Badfish Creek; however small populations of Lepomis cyanellus, Lepomis macrochirus, and Micropterus salmoides exist, suggesting that the degradation of the fish community in the lower portion of Badfish Creek has not been as severe as in the upper regions.

The Wisconsin Department of Natural Resources has classified the Oregon Branch of Badfish Creek as continuous surface waters not supporting a balanced aquatic community downstream to County Trunk A. From the County Trunk A bridge and for the remainder of Badfish Creek, the stream classification was determined to be continuous fish and aquatic life. It justified this classification based on the previous condition of Badfish Creek as reported by various sources and based on its estimate of the stream's potential without wastewater discharge (WDNR memoranda dated April 14, 1977 and May 3, 1977).

The algae of the Madison lakes were studied as part of MMSD's facilities planning. Results of this study were discussed in Chapter 2, Section D of this EIS.

An area of special concern which may potentially be affected by treatment plant expansion is Nine Springs Creek and the adjacent wetlands. The Creek has been channelized in the vicinity of the lagoons (See Figure 2-6). It flows around the south and east perimeters of the sludge lagoons and then through the wetlands out to the Yahara River. The plant cover mapping shown on Figure 2-7 was done in 1973 by the

Wisconsin Department of Natural Resources as part of a study of the Upper Mud Lake wetlands. The wetlands cover about 800-900 acres. The area has been ditched. The vegetation consists of sedges, cattail, and other species.

See Figure 2-7 for more detailed species information. Wildlife is prevalent and consists of a variety of shore birds, nesting birds, and small mammals. The area beyond the perimeter of the wetland consists of Lake Waubesa and farmland while more intense development lies to the west. Wildlife is still prevalent in the surrounding agricultural land, more so than in the developing areas bordering the plant site to the west.

More detailed information on habitat and vegetation can be found in Volume IV, Appendices A, B, D and E of MMSD's facilities plan.

2. Fauna

Section 2.07 of the environmental assessment summarizes native fauna of the study area. Additonal information is included in Volume IV, Appendices A, D and E of MMSD's facilities plan. However, that information is voluminous in nature and has therefore not been reproduced in this report. Section 2.07 is adequate with some supplementation.

Table 2-6 in the environmental assessment was compiled from "Surface Water Resources of Dane County" WDNR, "Surface Water Resources of Rock COUnty", 1970, WDNR and "Wisconsin Mapped Lakes", Clarkson Map Company. More recent sampling was completed for Badfish Creek and the Yahara River in 1975 by John Magnuson and Gary Herbst from the University of Wisconsin. That survey showed additional species existing in the Yahara River such as bluegill, crappie, and white bass. Their Badfish Creek survey data show some trout and bluegills living there in addition to those shown on the table. Section El on habitat contains a discussion of general conclusions of their study.

Hiesenhoff and Karl (1975) analyzed the macrolnvertelirate fauna of Badfish Creek, Rutland Branch and the Yahara River. From their evaluation of the diversity and community structure of the macroinvertebrate fauna they concluded that effluent from the Madison Metropolitan Sewerage District's Treatment plant has a profound effect on Badfish Creek. They determined that the upstream sites surveyed in Badfish Creek had been most affected, with significant recovery occurring in the lower reaches of the Creek. They also concluded that the most important reason for faunal alteration to be due to depressed levels of dissolved oxygen during the summer months, although high levels of nitrogen, phosphorus, sodium, chloride and other ions undoubtedly also had an effect. Related to the impact of Badfish Creek on the Yahara River, Hilsenhoff and Karl concluded that the effects on the macroinvertebrate fauna in the Yahara River are noticeable but much less profound than the effects on Badfish Creek.

Nine Springs Creek in the vicinity of the Nine Springs Sewage Treatment sludge lagoons is channelized. This Agency was not able to obtain fish sampling data for Nine Springs Creek close to Nine Springs Sewage Treatment Plant. However, the Department of Natural Resources conducted a fish sampling program upstream of Nine Springs Sewage Treatment Plant in the summer and fall of 1972 and 1973 using shocker gear pulled up the creek. The 29 species of fish sampled there should represent some of the fishes from the Yahara River and up through the wetland areas around the treatment plant since the fish move freely up the creek from the river. A list of the fish species sampled at the upstream location can be found in Appendix B.

3. Sensitive Natural Areas

Section 2.10 of the environmental assessment summarizes sensitive natural areas. As indicated in that section there are many sensitive natural areas and areas of scientific interest in the study area which should be protected from destruction. Volume IV Appendix A of the facilities plan lists 40 such areas in Dane County and 23 areas in Rock County. Of these areas only one site would potentially be affected by this project. It is the wetland area discussed in the previous section of this EIS which discusses habitat.

F. Air

1. Air Quality

Section 2.08, page 2-19 of the environmental assessment presents an adequate discussion of air quality in the study area.

2. Noise

There has been no discussion of noise levels in the project area in the environmental assessment. In 1970, the Madison Standard Metropolitan Statistical Area (SMSA) had registrations of 494 motor vehicles per 1000 population and 16 motor cycles per 1000 population. A recent USEPA publication used this index of vehicle registration as an index of noise population with the Madison SMSA ranking 19th and 37th lowest, respectively, for these two categories among 83 in the quieter half of those towns of its size surveyed. This kind of an analysis could be somewhat misleading considering that the study area includes both urban and rural areas which would by their nature have different noise sources and levels. However, we were not able to obtain any better information.

The normal operation of the Nine Springs Sewage Treatment Plant creates no significant noise impacts. Therefore, no conflicts with adjacent land uses are expected

3. Odor

The environmental assessment does not present an adequate picture of potential odor problems in the project area. Since the majority of the project area is agricultural land, it would be expected that the types of odor sources in these areas would be typical of agricultural areas. In addition, Nine Springs Sewage Treatment Plant has been reported as an odor source to the Wisconsin Department of Natural Resources; however, no action orders have been issued to MMSD. Processes such as the trickling filters and grit dump in the lagoon were significant odor producers in the past. The potential for odor problems would be minimized or eliminated by implementation of the facilities plan proposed by MMSD since these processes will be abandoned or modified as part of the plan.

G. Land Use, Zoning and Development Trends

1. Existing Land Use in General Study Area

Section 6.01G, page 6-4 of the summary facilities plan and Section 2.09, page 2-20 and Tables 2-10, and 2-11 on pages 2-21 and 2-22 of the environmental assessment present an adequate summary of existing land uses in the general study area (the entire area considered for both plant siting and ultimate discharge). Additional information can be found in Volume IV, Appendix A, Section 2 of the facilities plan.

2. Future Land Uses and Development Trends in the General Study Area

The facilities plan and environmental assessment include only a minimal amount of discussion of future land uses and development trends for the study area in general. To provide a better picture of future land use and development trends for the general study area the following information was extracted from Volume IV, Appendix A of MMSD's facilities plan.

> "Definite statements cannot be made regarding future land use trends. The lack of strong, uniform land use planning implementation programs (personal communication, Mary Louise Symon, Dane County Board Chairman), and uncertain factors such as future birth rates and economic development prohibit a clear estimation of future land use requirements. There is also no assurance that the trends noted in the past decade are indicative of long range land use patterns. However, based on the data available for the 1964 to 1973 period, some general land use trends seem apparent.

"Agricultural land use will probably continue to decline for a number of reasons. Increased production per acre of farm land will probably require that less land will be needed to produce the crops needed to feed increased future populations. Also, present economic conditions have led to a decreasing number of farms in operation. Table 2.09-4 (Volume IV, Appendix A, of MMSD's Facilities Plan) summarizes the data available regarding the number of farms and farm acreage in the State and Dane-Rock County area in the past.

"These figures indicate a steady decline in both the total number of farms in operation and in the total number of acres devoted to agricultural practices on a statewide basis. Dane and Rock Counties do not seem to be affected as greatly.

"Population increases will require that additional lands be developed for housing, commercial establishments, services, utilities, etc. It is also anticipated that increased demand for recreation facilities will result in an increase of acreage devoted to this purpose.

"The Land Use Plan (DCRPC, 1973) projected that an additional 21,000 acres of land would be developed by the year 1990. This was based on a population projection of over 455,000 for that year. Since 1973, the population projection has been revised downward to 400,000 for the year 2000. Demand for additional land development (housing, commercial, transportation, utilities, services, etc.) might be expected to respond to changing population projections. It can be anticipated that most new development would occur at the fringes of existing developed areas.

"As stated above, neither Dane nor Rock County have a strong county-wide zoning ordinance in effect which would afford direct land use control. Development can be controlled indirectly, however, through the sanitation code and through the authority to review federally funded development projects as well as state funded water quality improvement projects."

One of the assumptions made by Dane County Regional Planning Commission in preparing their forecasts for area socioeconomic development is that an increasing proportion of future population increases will be located outside the Central Madison Urban Services Area.

3. Land Use and Development Trends in Vicinity of Nine Springs Sewage Treatment Plant Expansion Site

Land use around the existing Nine Springs Sewage Treatment Plant site was not discussed in the summary facilities plan or environmental assessment. Since a large portion of this planning effort is related to construction and operation of expanded treatment facilities, we are providing additional information on the subject. The following information was extracted from Volume II, Section 5 of MMSD's facilities plan. It discusses constraints related to land use, zoning and development trends which the MMSD and its consultants used as a background to aid them in making plant siting decisions for treatment plant expansion. Reference is made in the text to various figures from Volume II, Section 5. We have included these figures in the EIS and have noted their new figure numbers in parentheses.

"The study area and its surroundings are in transition. The farmlands and open spaces are gradually being inundated by urban and suburban uses. The reasons for this are linked to growth, development policy, and suburban scatter. The study area, in particular, has a number of attributes which contribute to its development: access to the beltline is convenient, its location is near the urban core, utilities and other urban services are nearby, and the uplands have excellent terrain for homesites.

"Because of the area's physical attributes and location, a mix of uses seem to be competing for the area. Industrial, commercial, open space, and a range of residential densities are all placing demands upon the land. These uses, particularly residential, are encroaching upon the Nine Springs plant. To a limited degree, discord between the encroaching uses and the treatment plant have evolved. This often happens where a mix of development is allowed to encroach upon such utilities as airports, landfills, and treatment plants, only to find out that some facets of the operation are incompatible with residential areas. So far, discord has become evident only through occasional complaints about odor from the grit dump.

"Four municipalities have jurisdiction in the environmental study area: the Town of Blooming Grove, the City of Madison, the City of Monona, and Dane County. Figure 5-2 [See Figure 2-8 in EIS] shows the area for each jurisdiction. Approximately 20 percent of the area is within the City of Monona, 45 percent within the City of Madison, and the remainder in Dane County.

"Zoning ordinances are administered by the respective jurisdictions within the study area. Current zoning is shown in Figure 5-2 [See Figure 2-8 in EIS]. Land adjoining the treatment plant on the north is zoned industrial; the lands to the west are zoned manufacturing, agricultural, conservancy and residential. The areas to the east and south of the plant are zoned manufacturing, agricultural and planned residential development.

"Existing zoning is compatible with the present operation of the Nine Springs plant, but a mix of uses, including residential, has developed near the plant. Any nearby residential development can be considered a potential source of opposition to the further expansion of the plant.

"Figure 5-3 [See Figure 2-9 in EIS] shows current land uses in the area. The plantsite is bound on the northeast, east and southeast by undeveloped property. Industrially zoned property to the northeast can be expected to develop in the future, while land to the east and southeast has limited development potential. Property immediately south of the plant is a mobile home subdivision. The area farther south and to the southeast is under cultivation. An undeveloped parcel of land lies immediately west of the plant, with an apartment complex and residential subdivisions beyond to the west. Land to the northwest is undeveloped, and an industrial complex lies to the north.

"Figure 5-4 [See Figure 2-10 in EIS] delineates ownership groups in the study area. The groups are (1) private ownership, (2) property owned by the District, and (3) other public ownership. The land held by each sector is itemized below.

Private Ownership	1,450 acres
MMSD	433 acres
Public Ownership	385 acres

Ownerships are held in large parcels; most exceed 40 acres.

"Future land planning is coordinated by the Dane County Regional Planning Commission. Existing trends in the area have influenced local land use planning. As shown in Figure 5-5, [See Figure 2-11 in EIS] the area west of the plant is a mix of industrial, residential and commercial usage; the area to the south is largely low-density residential. The land use plan conforms to the "E-way corridor" concept. The basic framework for the "E-way" system consists of public roads, streets, walkways, and open space systems. These connected corridors enclose the city in an environmental loop, which highlights its prominent educational, ecological, and environmental characteristics.

The corridor widens in the study area to include the wetlands a unique feature in the plant site study area.

"Several projects in the area have been slated for development. One of the most significant projects involves the realignment of the South Beltline at the northern edge of the study area. Figure 5-6, [See Figures 2-12 and 2-13 in EIS] shows the proposed alignment, as well as property acquisition requirements. The E-way corridor is a second project that proposes to involve a great deal of land in the study area. The proposed property boundaries of the corridor are shown in Figure 5-6, [See Figures 2-12 and 2-13 in EIS]. Acquisition and implementation is expected to be a long-range activity. Last, a prominent commercial shopping mall has been proposed on the north edge of the South Beltline."

H. Demography and Economics

Section 5.02 and Section 6.01 of the summary facilities plan and Sections 2.09 and 2.11 of the environmental assessment present an adequate summary of population data and socioeconomic trends in the study area. Additional more detailed supporting documentation can be found in Volume IV, Appendix A, Section 2.11 and Volume VI, Appendices K and N of the facilities plan.

I. Summary of Sensitive Man-made Resources

1. Historical and Archaeological Resources

Section 6.01 of the summary facilities plan and Section 2.16 of the environmental assessment discuss historical and archaeological sites in Dane and Rock Counties including twenty-six sites which have been listed in the National Register of Historic Places. More detailed documentation can be found in Volume IV, Appendix A, pages 2-196 through 2-202 of the facilities plan.

As part of their facilities planning effort MMSD's consultants corresponded with the State Historic Preservation Officer to determine whether the plan could potentially affect any historical or archaeological resources. The proposed actions being evaluated by the State Historic Preservation Officer (SHPO) were primarily treatment facility site expansion and application of sludge to agricultural land since MMSD has proposed to continue discharge of effluent to Badfish Creek and the pipeline is already in place. If, at a later date, a different pipeline route selected, the SHPO would again be consulted. In a letter dated June 4, 1976, (Included in Appendix C) the SHPO indicated that the sludge application program would have no impact on archaeological or historical sites. The SHPO recommended that the area recommended for the location for the expanded treatment plant be surveyed by a qualified archaeologist to determmine whether any sites would be affected by treatment facility construction. MMSD hired a qualified archaeologist to perform this survey. The State Historic Preservation Officer reviewed the results of the survey. In a letter dated August 31, 1977, the SHPO indicated that the site is not eligible for inclusion on the National Register and that the significance of this site is negligible in terms of archaeological values.

2. Recreation and Open Spaces

Section 2.13 of the environmental assessment provides a summary of recreation resources in Dane and Rock Counties. Additionally, the previous section of this chapter on natural vegetation and wildlife discussed open space areas of natural value and scientific interest. Additional documentation is in Section 2.13 of Volume IV, Appendix A of the facilities plan including a list of parks in Dane and Rock Counties. The following two paragraphs were extracted from that section to give a better idea of the importance of water-oriented recreation in Dane and Rock Counties.

> "In Dane County, the Madison Lakes provide an excellent boating and fisheries resource. There are twenty-three additional lakes in the county able to support fish populations (WDNR, 1961). The major rivers in the county are the Wisconsin, Yahara and Sugar Rivers. Each provide good fishing and boating or canoeing opportunities. Many of the tributaries to these rivers offer good fishing also. There are a total of 421.4 miles of rivers and streams in the county (excluding the Wisconsin River). Approximately 70 miles of the streams in Dane County are listed as trout streams, capable of supporting trout populations (WDNR, 1974).
>
> "Rock County's primary recreational water resource is the Rock and Yahara River system. These rivers provide fishing and boating opportunities. There are a total of 308.7 miles of streams in the county of which 107.9 miles support a warm water fishery. A section of one stream, the East Branch of Coon Creek located in the Town of Beloit, is classified as a trout stream and totals 3.0 miles in length (WDNR, 1974). In addition to the rivers and streams, there are several small lakes and ponds which support a fish population (WDNR, 1970).

The environmental assessment did not present information on recreation and open space areas in the vicinity of Nine Springs Sewage Treatment Plant site. Therefore, the following discussion is provided.

As can be seen on Figure 2-12, a large portion of land immediately to the south and east of the treatment plant and sludge lagoons is in public ownership. This land is being held for recreation and open space use. The public agencies owning land include the State of Wisconsin, Dane County, and MMSD. A portion of the area to the north of the sludge lagoons is designated as open space (See Figure 2-11) in the land use plan. The area is currently undeveloped. However, it is in private ownership. As shown on Figures 2-12 and 2-13 it is included as part of the E-way corridor system.

3. Agriculture

The summary plan and environmental assessment provide little information on agriculture in the study area. The previous section of the EIS on land uses briefly describes agricultural land use trends. The following information was extracted from Volume III of the facilities plan related to MMSD's sludge management plan. (The organic solids reuse plan was considered in a seperate EIS). The area discussed is Dane County the area of greatest potential impact.

> "The major crops grown in the study area are field corn, 40,000 acres; small grains (including oats, barley, and wheat), 5,600 acres; and alfalfa, 15,000 acres. The field corn consists of about 75 percent grain corn and 25 percent silage corn. Other crops commonly grown include soybeans, potatoes, tobacco, processing peas, sweet corn, hay other than alfalfa, and pasture or greenchop grass and legumes. There are approximately 550 farms in the study area, covering 91,000 acres or about 165 acres each (Wisconsin Statistical Reporting Service, 1974).
>
> "Dane County ranks high in agricultural production in Wisconsin. In 1973 Dane County led production in grain corn, silage corn, alfalfa hay; and was a major producer of processing peas, livestock and dairy products. Dane County's outstanding agricultural production is further emphasized by Wisconsin's No. 1 nationwide ranking in production of dairy cattle, mild, cheese, corn silage, all hay and green peas for processing (Walters 1974). The grain crops are fed to the farmer's own cattle or sold on grain markets. The dairy cattle are increasingly kept on feedlots. Forage is either in the form of dried hay or greenchop rather than pasture. The weather and prices paid for crops play a very important part in determining the types and amounts of crops planted. A late wet spring, for instance, may cause substitution of the types of crops planted.

4. Energy Resources

Electric utilities in the study area and MMSD energy usage are adequately summarized in Section 2.15 of the environmental assessment.

Other present or projected electrical power, natural gas and heating oil needs in the study area were not identified. The Upper Mississippi River Comprehensive Basin Study published in 1970 predicts a substantial increase in energy requirements in the basin between 1970 and the year 2000. The figures cited for Power Supply Area 13, which includes Dane County, show that energy requirements will increase from 9,690 million Kwh in 1970 to 50,560 million Kwh in the year 2000. While these predictions may have changed somewhat since 1970, it can be expected that there will be an increasing demand for energy as the population increases.

CHAPTER 3
EVALUATION OF ALTERNATIVES

A. INTRODUCTION

The summary plan and environmental assessment for wastewater treatment and discharge of Madison Metropolitan Sewerage District provides an accurate summary of how the alternatives were developed for this project and resulted in MMSD's proposed plan. The summary plan, environmental assessment and the other volumes of MMSD's facilities plan provide extensive documentation of alternatives development and environmental analysis.

In preparing this EIS we have attempted to insure that all feasible alternatives have been considered; that the environmental and socio-economic effects of those alternatives have been evaluated to the level necessary to determine the most cost-effective project; and that the public has been made aware of the tradeoffs involved in implementing the proposed alternative and the "no action" alternative.

In this Chapter we will evaluate the information in the summary plan and environmental assessment on the development of alternatives for this project and supplement or clarify it as necessary. There are certain portions of MMSD's alternatives evaluation rationale and conclusions with which this Agency does not agree. In addition some recent proposals by the Wisconsin Department of Natural Resources announced subsequent to the completion of MMSD's facilities plan affect the evaluation of alternatives.

It should be realized in reviewing the summary plan, environmental assessment and this EIS that sludge treatment, handling, and disposal were the subject of an EIS previously completed. This EIS will only discuss treatment and discharge alternatives. However, the costs of the various alternatives which will be presented do include the costs of sludge treatment and handling alternatives as information only and are not subject to review as part of this EIS.

B. PRELIMINARY SCREENING OF ALTERNATIVES

Section 7 of the summary plan and Section 3 of the environmental assessment discuss the preliminary screening of alternatives. After an extensive review of past studies, a review of area topographical maps and interviews with knowledgeable people in the area, twenty three separate final discharge sites were developed for consideration. These included both surface and groundwater discharge strategies. Because the water balance situation in the Rock and Yahara River basins was considered to be of great importance in evaluating discharge alternatives, the alternatives were divided into five distinct categories depending on their effect on water balance in those river basins. Each of the surface water discharge alternatives were then evaluated in sufficient detail to allow a determination of the degree of treatment required for each discharge alternative to protect the receiving stream's and surrounding area's environment. The effluent limits for land application were similarly evaluated. Once the required degree of treatment was determined, preliminary cost estimates for treatment and conveyance were developed and compared for the alternatives. A preliminary environmental impact evaluation was also completed comparing the effects of these alternatives. A comparison of the operational reliability and flexibility of these alternatives was also completed. Finally, an evaluation of technical and legal constraints affecting these alternatives was completed. Refer to Section 7, pages 7-1 to 7-20 of the summary plan and Section 3, pages 3-1 to 3-11 of the environmental assessment for a summary of this preliminary evaluation. More detailed information can be found in Volume V, Appendix F of the facilities plan.

Although we found that this preliminary screening was completed systematically, we do feel that there is a basic inadequacy of the alternatives evaluation rationale which requires discussion.

The screening process involved consideration of the effects of each alternative in four basic areas: cost, environmental impact, reliability and flexibility, and technical and legal constraints. A matrix scheme was utilized to compare the effects of various alternatives within each category. A net rating was then assigned to each alternative within each category. All the net ratings for each alternative for each category were then summarized and a total net rating was assigned. Based on this final net rating the alternatives to be further studied were recommended. This type of matrix alternatives evaluation scheme serves a useful purpose in allowing a display of the various effects of each alternative and a comparison of alternatives. However, it should be used carefully. Two of its most serious limitations lie with the subjectivity of the process and the problems with assigning net ratings. Using the same information, two different groups might assign just slightly different ratings which could affect the end result of the matrix screening process. The selection of the parameters to be compared can also be subjective. The use of net ratings is not entirely appropriate in some situations because it attempts to sum the effects of alternatives which are not summable and can result in masking the tradeoffs involved. In this particular situation there are environmental tradeoffs which are not very amenable to a net rating process. Protecting the water quality of the stream receiving the effluent and protecting the water balance in the Rock and Yahara River Basin are two serious constraints involved in the selection of the ultimate discharge site. Either of them is important enough to be the basis for retaining or eliminating alternatives. Assignment of a net rating tends to mask their importance. In summary, the matrix evaluation scheme should only be used keeping these constraints in mind and pointing out any problems where they occur.

In the case of this preliminary screening using the same information as MMSD's consultants, we feel that the Wisconsin River alternative should have been immediately eliminated from consideration on the basis of its high cost particularly for the investment in transmission facilities and because of its effect of transferring a large amount of water entirely out of the Rock and Yahara River Basin. We also feel that the proposed Koshkonong Nuclear Power Plant alternative should have been eliminated in the preliminary screening because of the lack of information on its environmental effects and the question of its implementability within a reasonable time period. For these reasons our evaluation of final alternatives will not include consideration of the proposed Koshkonong Nuclear Power Plant alternative or the Wisconsin River alternative.

C. COMPARISON OF FINAL ALTERNATIVES IN MMSD'S FACILITIES PLAN

As pointed out in Section 8 of the summary plan and Section 3 of the environmental assessment, MMSD and its consultants performed detailed studies to provide the information necessary to evaluate the final alternatives. These included a comprehensive literature search, an effluent characterization program and a review of the water quality goals adopted in their Plan of Study and comparisons of projected qualities with the water quality required for each of the potential beneficial uses of that stream. The levels of treatment provided for each alternative were then reviewed to assess the validity of the initial assumptions made during the preliminary screening process. The detailed "basis of design" was then finalized for each treatment alternative and cost estimates were made to be used in cost estimating of the alternative treatment strategies. The alternate treatment strategies were then compared for each level of effluent quality and the most cost effective treatment system was chosen for each alternative. A "basis of design" was established for each discharge alternative and cost estimates were prepared for each discharge system. The total cost for each treatment and discharge alternative was then estimated. Each of the treatment discharge alternatives were then rated with respect to the categories: present-worth cost, environmental impact, reliability, flexibility and implementability. After the final comparison of alternatives was completed based on these five categories, a final treatment and discharge strategy was recommended.

Subsequent to the completion of MMSD's facilities plan and MMSD's submittal of the plan to the Wisconsin Department of Natural Resources and this Agency for review, the Wisconsin DNR proposed final effluent limitations to be met by the Nine Springs Sewage Treatment Plant for discharge to Badfish Creek. The effluent limits proposed by the Wisconsin DNR for inclusion in the NPDES permit vary somewhat from the effluent level for discharge to Badfish Creek proposed in the facilities plan. The most significant difference is in the level of ammonia nitrogen allowed in the effluent.

These two different limits are as follows:

Table 3-1
Effluent Limits for Discharge to Badfish Creek

NPDES Effluent Limits Proposed by Wisconsin DNR

	Monthly Average	Maximum Daily
BOD	8 mg/l	15 mg/l
Suspended Solids	*	*
Ammonia Nitrogen	1 mg/l (summer) 3 mg/l (winter)	2 mg/l (summer) 5 mg/l (winter)

* Based on design criteria

Assumes effluent aeration and minimum dissolved oxygen level in effluent of 6 mg/l.

Effluent Limits Proposed in MMSD's Facilities Plan

Monthly Average

8 mg/l BOD
8 mg/l Suspended Solids
0.43 mg/l Ammonia Nitrogen (summer)

The effluent limit for discharge to Badfish Creek proposed in the facilities plan was based on the detailed studies outlined above including water quality predictive modeling by MMSD's consultant. The assumption used in their modeling was that discharge to Badfish Creek would require an effluent which would attain full fish and aquatic life standards in all reaches of Badfish Creek. Their detailed assumptions can be found in Volume V, Appendix F of the facilities plan particularly Section 5 which is a review of water quality goals and objectives for final alternatives. The levels they determined as necessary to provide for full fish and aquatic life in all reaches of Badfish were a minimum of 5 mg/l dissolved oxygen at all times and a maximum level of 0.02 mg/l un-ionized ammonia nitrogen.

The level of 0.02 mg/l un-ionized ammonia is recommended in Quality Criteria for Water, 1976, as the level necessary to protect fish from toxic effects. The percentage of total ammonia that exists in an un-ionized state is mainly dependent on the pH and temperature of the receiving waters. It can, therefore, vary throughout, the year, being most stringent in summer when stream temperature and pH conditions are most critical.

The effluent limits for discharge to Badfish Creek proposed by the Wisconsin DNR for inclusion in the NPDES permit were based on the results of modeling studies and other information. In addition to the modeling completed as part of MMSD's facilities planning and presented in Appendix I of the plan, WDNR collected additional data and had additional modeling verification work and predictions completed by Limno-Tech, the same firm that had completed the modeling for the facilities plan. The results of this additional modeling verified that a BOD level in the range of 8-10 mg/l would provide at least 5 mg/l DO in all reaches of the stream. However, it would be only slightly above at some locations. (WDNR memo dated April 4, 1977). The proposed ammonia nitrogen limitation is based on meeting critical conditions in downstream reaches (below CTH A) of Badfish Creek. The WDNR memo cited above states that "Given critical temperature conditions and a pH of about 7.5, the value of total ammonia nitrogen allowable to stay within a maximum limit of 0.02 mg/l ammonia in the water is approximately 0.8 mg/l. Because there is little nitrification occurring in the Creek, it is recommended that the ammonia limitation in the MMSD permit be 1.0 mg/l." From the information available to this Agency it appears that the 1.0 mg/l ammonia nitrogen limit would also protect the upper reaches of the Creek from toxic effects.

The final treatment-discharge alternatives which were evaluated in MMSD's facilities plan included discharge to the proposed Koshkonong Nuclear Power Plant, with a back-up discharge to the Rock River, discharge to the Wisconsin River, discharge to Badfish Creek, a split discharge to Badfish Creek and the Yahara River, and discharge to the Yahara River. For the reasons previously discussed we have eliminated the Wisconsin River and Koshkonong Plant alternatives from consideration. The Yahara River and Yahara-Badfish Creek split discharge alternatives which will be evaluated in this EIS are those evaluated as final alternatives in the facilities plan and environmental assessment. The WDNR proposed effluent limitations have no effect on them since the effluent level which must be met by both alternatives is for the more stringent ammonia level required for discharge to the Yahara River. The effluent limit for discharge to Badfish Creek which will be used in this EIS and will serve as the "basis for design" of the treatment facilities for that alternative is the proposed WDNR effluent limitation discussed previously. Since the WDNR effluent limitation involves a less stringent ammonia nitrogen removal level, the treatment facilities for this alternative which will be discussed in this EIS will vary from those presented for the Badfish Creek final alternative evaluated in MMSD's facilities plan.

This Agency considered whether this change in effluent limits for discharge to Badfish Creek would have changed the results of the preliminary screening of discharge alternatives. Since it appears that the outcome would have been the same, there will be no attempt to revise or repeat the preliminary screening process in this EIS.

Section 8 of the summary plan and Section 3 of the environmental assessment evaluate five final treatment-discharge alternatives. However, only two of the alternatives evaluated there are exactly the same as the final alternatives proposed here. The transmission facilities for the Badfish Creek alternative evaluated there are the same as what will be evaluated in this chapter. To avoid confusion, our evaluation will not refer to the evaluation of final alternatives presented in those sections. However, as it applies, we will use the information presented in those sections and other portions of the facilities plan, and reference appropriately. We will also briefly evaluate the "No Action" alternative.

D. EVALUATION OF REMAINING ALTERNATIVES AND "NO ACTION" ALTERNATIVE

"No Action" Alternative

Continued discharge to Badfish Creek with no new or upgraded facilities beyond those constructed as part of the Fifth Addition and as part of the Organic Solids Reuse Plan.

Alternative #1

Discharge to the Yahara River with effluent meeting the highly nitrified level defined as "Effluent II" in MMSD's facilities plan.

Alternative #2

Split discharge to Badfish Creek and the Yahara River with effluent meeting the highly nitrified level defined as "Effluent II" in MMSD's facilities plan.

Alternative #3

Continued discharge to Badfish Creek with effluent meeting Wisconsin Department of Natural Resources proposed limitations for discharge to Badfish Creek.

Each of these system alternatives will be evaluated under the following categories:

A. Present-Worth Cost

B. Ability to Meet Receiving Stream Water Quality Goals and Objectives

C. Environmental Impact

D. Reliability

E. Flexibility

1. "No Action" Alternative

The "No Action" alternative for this project would be to use the facilities at Nine Springs STP as they will exist after the Fifth Addition and the approved sludge treatment, handling and reuse facilities and program are operational. The effluent from Nine Springs STP would be transmitted to Badfish Creek via the existing facilities. The "no action" alternative is compared with the three final alternatives in Table 3-8 in summary form.

The "No Action" alternative has been rejected because it will clearly not meet national water quality goals and because it would create severe environmental impacts. Although water quality modeling was not completed for the "No Action" alternative, we expect that the "No Action" alternative would provide extremely poor water quality conditions in Badfish Creek by the end of the planning period. As was discussed in MMSD's facilities plan, additional upgrading of secondary treatment facilities would be necessary even after the Fifth Addition comes on line to provide adequate secondary treatment for the additional flows projected during the planning period. Without the construction of the proposed advanced waste treatment facilities Badfish Creek will be subject to severe loadings of organic and inorganic toxicants. Population growth and land use patterns in the Madison area could be severely impacted by the "No Action" alternative if sewer hookups are restricted.

2. Alternative #1 - Discharge to Yahara River

a. Description of Alternative:

(1) Transmission Facilities and Routing

The proposed point of discharge to the Yahara River would be south of Stoughton and east of County Highway A along the division of Sections 8 and 17 in the Town of Dunkirk. This routing is shown on Figure 3-1. This alternative would utilize the existing 54 inch force main presently used to convey MMSD wastewater to Badfish Creek. The existing effluent motors and pumps would be replaced by 1500 HP motors and higher head pumps. A new 72 inch force main would be connected to the end of the existing line. The new 72 inch force main would extend approximately 57,000 feet to the proposed point of discharge. No stream channelizing would be necessary with this alternative.

(2) Effluent Quality Limitations

The Yahara River is an intrastate waterway with stream standards for the maintenance of fish and aquatic life and recreational use. The water quality modeling and other studies completed as part of MMSD's facilities planning indicated that the effluent from Nine Spring Sewage Treatment Plant should meet the following limits (defined as "Effluent II") in order to adequately protect fish and aquatic life and recreation in the Yahara River (Refer to Chapter 8 of the summary plan and Section 3 of the environmental assessment for a summary of how these effluent limits were determined). Volume V of the facilities plan provides detailed information on how these effluent limitations were developed.

	Monthly Average	Daily Maximum
BOD	8 mg/l	6 mg/l
Suspended Solids	8 mg/l	16 mg/l (summer)
Ammonia Nitrogen	0.1 mg/l (summer)	0.4mg/l (summer)

(3) Treatment Facilities

Section 8.04 of the summary plan and Sections 3.08 and 3.09 of the environmental assessment summarize the selection process for treatment alternatives. Volume II of the facilities plan provides a detailed analysis of wastewater treatment systems. The level of treatment required for effluent which will be discharged to the Yahara River is defined as "Effluent II" in the above-referenced sections of the facilities plan. Since we feel that MMSD's analysis of treatment systems for this alternative is satisfactory, their selected treatment system for Effluent II has been assumed in this treatment-discharge alternative system. The additional treatment processes which would be required to meet the above-defined effluent limitations would include the following:

1. Improved secondary treatment
2. Nitrification (utilizing rotating biological contactors)
3. Filtration
4. Break-point chlorination
5. Dechlorination
6. 12-hour Effluent Equalization

The process schematic for this alternative is shown in Figure 8-5 of the summary plan.

b. Present-Worth Cost of Alternative #1 (Yahara River Alternative):

Effluent Treatment	$42,590,000
Effluent Pumping	5,085,000
Transmission	9,548,000
Total Present Worth	$57,223,000

More detailed breakdowns of these costs can be found in Appendix A, Tables A-1 and A-2.

c. Evaluation of System's Ability to Meet Receiving Stream Water Quality Goals and Objectives:

The mathematical modeling completed as part of MMSD's facilities planning indicated that:

"The discharge of MMSD effluent to the Yahara River at the Q7, 10 flows projected for the year 2000 might result in some improvement in the dissolved oxygen in the stream. D.O. levels, however, could continue to be below the 5 mg/l level required for protection of fish and aquatic life unless some action is taken to reduce the levels of phytoplankton activity in the stream."

Appendix I of MMSD's facilities plan, however, points out that this modeling relied heavily on estimates of algal respiration and sediment oxygen demand, that these estimates were conservative, and that a steady-state model was used instead of a dynamic one. It would appear that the modeling projections discussed above may be somewhat conservative and that D.O. levels in the Yahara River with addition of MMSD effluent may be somewhat higher than projected. However, the modeling was based on the best information available and presents the best estimate of the impact of MMSD's effluent on Yahara River conditions.

d. Evaluation of System's Environmental Impact:

(1) Impacts Resulting from Treatment Plant and Pump Station Construction

(a) Impact on Water Quality

The treatment plant and pump station's direct impacts on the water quality would be limited to those water bodies (Nine Springs Creek, Lake Waubesa) in the immediate area of the facilities and would be the result of construction activities.

Due to required earth moving operations to install new treatment and pumping facilities, exposed soil may be subject to erosion. By utilizing recognized construction methods such as providing adequate site drainage where required, the amount of material lost through erosion can be minimized.

There may be periods during the construction when the wastewater may have to be re-routed around some portions of the plant. However, the degree of treatment provided during these periods must be at least equal to that achieved prior to construction. The development of the final design and specifications for the construction of the treatment plant facilities should include provisions for the maintenance of the present effluent quality at all times during construction.

The overall impact of an upgraded degree of treatment is felt to outweigh the temporary impacts of the construction activities.

(b) Impact on Use of Surrounding Lands

The major impact of the treatment plant is the utilization of additional land areas for expansion of the treatment plant.

While the presence of the treatment plant could have a detrimental impact on the land use in the immediate vicinity of the plant from an aesthetic standpoint, it should be noted that encroachment of both commercial and residential development has taken place in recent years. Proper zoning of the area surrounding the treatment plant site would provide a buffer zone between the treatment plant and other land use activities. Impacts on surrounding land use would then be kept at a minimum both now and in the future.

(c) Impact on Air Quality

There will be a temporary decrease in air quality during construction activities in the form of increased dust levels near the construction site.

(d) Impact on Energy Utilization

The vehicles and equipment required to perform the treatment plant and pump station construction activities would consume energy in the form of fuel required for operation.

(2) Impacts Resulting from Pipeline Installation

(a) Impact on Water Quality

The Yahara River discharge alternative would require a new pipeline from the end of the existing pipeline to the Yahara River south of Stoughton. No major stream crossings would be required. The pipeline would be routed along roads in existing rights-of-way wherever possible.

As with the construction of the treatment plant and pump station, required earth moving operations during the installation of the pipeline would allow erosion of exposed soil during rainy periods. Runoff, carrying the soil particles, would result in increased siltation of nearby streams. Where it would be necessary that a stream be crossed, there would be a direct disturbance of the streambed and adjacent banks.

New pipeline construction would also require excavation and back filling operations in addition to the stream crossings noted above. Such construction necessitates the disruption of the ground surface and vegetation. In order to minimize the impact on any unique or scarce plant community, sites which have been inventoried by WDNR's Scientific Areas Preservation

Council (described in Vol. IV, App. A of MMSD's facilities plan) would be avoided. Plans and specifications would require that vegetative cover be restored at the completion of pipeline installation. As mentioned previously, the pipeline would be routed along existing rights-of-way wherever possible.

(b) Impact on Use of Surrounding Lands

The existing discharge pipeline and effluent ditch were installed prior to the 1958 diversion of the effluent to Badfish Creek. There are negligible impacts felt from the presence of the pipeline as it is buried sufficiently deep to enable normal agricultural land use activities to be carried on above it. Development directly over the pipeline, such as the construction of buildings, is prohibited. The ditch, at the time of construction, was placed in agricultural and vacant land areas and did not interfere with any existing development. Since that time, some development has taken place in close proximity to the ditch and possible problems, not evident at the time of construction, have been brought to the attention of MMSD as listed below:

- hazards to the safety of children in the area by the relatively steep banks and the current in the ditch
- source of odors to surrounding residents
- hindrance to effective farm management by division of some farm fields
- generation of local fogging conditions due to temperature differentials between the atmosphere and the water in the ditch at certain times
- detrimental effects on muskrat farming in Grass Lake by lowering the water level through exfiltration

An investigation into these alleged problems concerning the existing effluent ditch indicated that some remedial actions could be taken. Encroachment of residential development has contributed to the safety hazard for children who might not otherwise have had the opportunity to be in the vicinity of the ditch. Zoning regulations may have helped to prevent such encroachment from occurring in the past. Placement of fencing along stretches of the ditch near existing development should alleviate a major portion of the safety hazards. Fogging conditions are normal occurrences on most streams but may be aggravated due to the generally warmer temperatures of the Nine Springs effluent. The equalization of the effluent flow would tend to bring the effluent closer to the atmospheric temperature prior to discharge, thus reducing the fogging potential.

At the time of the construction of the effluent ditch and improvements to the Badfish Creek, crossings were provided for those farmers requesting them. Other farmers accepted a cash settlement for any inconvenience caused by the effluent ditch.

Odor problems result from anaerobic conditions in the ditch. Improved treatment of the wastewater would maintain aerobic conditions, thus alleviating this problem.

Area residents felt that after construction of the effluent ditch around the area of Grass Lake in the Town of Dunn, the water level of the lake fell, causing a detrimental impact on the muskrat farming at the lake. It was their contention that water was seeping out of Grass Lake and into the effluent ditch. An investigation of this concern indicated that the effluent ditch, which flows from north to south, was placed at a higher elevation than the lake at the northern end to prevent such a condition. At the southern end of the lake, the effluent ditch is at a lower elevation than the lake. It was indicated by MMSD officials that the adjacent property owner had requested that a culvert be installed which would allow the level of the lake to be lowered. Such a culvert was installed as requested.

Installation of the pipelines necessary to convey the effluent from the Nine Springs treatment plant to the Yahara River would not lead to any of the problems noted above for the existing effluent ditch since it would not utilize any additional open ditch.

Any impacts on land use would be associated with the construction of these pipelines. There may be temporary disruption of traffic patterns in areas where a pipeline follows a roadway and temporary disruption of agricultural activities where the pipeline route traverses farmlands. After installation, land use activities would return to normal.

(c) Impact on Air Quality

There will be a temporary decrease in air quality during pipeline installation activities in the form of increased dust levels near the installation site.

(d) Impact on Energy Consumption

The vehicles and equipment required to install the pipeline to the Yahara River would consume energy in the form of fuel required for operation.

(3) Impacts Resulting from Operation of the Expanded Treatment Plant and Pumping and Transmission Facilities for Discharge to the Yahara River

(a) Impact on Water Quality

The potential impacts on water quality resulting from operation of the expanded facilities would be related primarily to the quality and volume of effluent discharged to the Yahara River. There would also be impacts on Badfish Creek resulting from removal of MMSD's effluent since the effluent has comprised the majority of the flow since the 1958 diversion.

The following sections describe the impact on various water quality parameters anticipated as a result of discharge to the Yahara River.

(a1) Dissolved Oxygen

The Yahara River below the Madison lakes currently has widely varying D.O. values with projected minimum valves falling well below the 5 mg/l level. This results from the photosynthetic and respiration activity of the phytoplankton present in the stream. The modeling completed as part MMSD's facilities planning indicates that with the discharge of effluent to the Yahara River during low flow conditions, the D.O. level would be improved slightly due to the higher reaeration rate induced by the increased flow. It would not, however, increase the D.O. to the 5 mg/l level at all times. As pointed out previously, this may be a conservative estimate of D.O. levels, but it is the best information available.

Presently, the D.O. values in the Badfish Creek fall below the 5 mg/l level and are due in part to the discharge of effluent from the Nine Springs and Oregon sewage treatment plants, which contribute to the oxygen deficits. If the Nine Springs effluent were to be removed from the creek, sediment oxygen demand would be expected to cause low D.O. levels until the sediment deposits become stabilized. Further improvement of stream D.O. levels could be provided by improving the Village of Oregon's wastewater treatment plant effluent quality and by the reducing agricultural runoff entering Badfish Creek.

(a2) Suspended Solids

The various treatment processes (such as filtration) included in this alternative would provide a high level of protection for the aquatic community from the standpoint of effects of suspended solids. All discharge alternatives are considered equal in this respect. Additional information can be found in the summary plan, Section 8, and Volume V, Appendix F of the facilities plan.

(a3) Temperature

The MMSD effluent temperature is expected to increase slightly due to the advanced treatment processes. Discharge to an essentially warm water stream such as the Yahara River is not expected to significantly affect the stream.

Discharge to the Yahara River would remove the effluent from Badfish Creek which would probably result in an average decrease in water temperature conditions in Badfish Creek. This average decrease in temperature in Badfish Creek would possibly improve the ability of the Creek to support fish intolerant to higher temperatures. However, the lack of the other environmental factors necessary to support fish preferring lower temperatures would probably negate this beneficial impact on Badfish Creek. Additional information can be found in Volume V, Appendix F of MMSD's facilities plan.

(a4) Total Dissolved Solids

The total dissolved solids levels in the Yahara River above its confluence with Badfish Creek could be expected to increase if the Nine Springs effluent would be discharged to that river segment. However, it is not expected to have any significant effect on the aquatic community. Additional information can be found in the summary plan, page 8-14 and Volume V, Appendix F of the MMSD's facilities plan.

(a5) Ammonia Nitrogen

This alternative would provide an effluent containing a monthly average of 0.1 mg/l ammonia nitrogen during critical summer conditions. This would provide for a level of 0.02 mg/l un-ionized ammonia nitrogen in the Yahara River during critical summer conditions which is recommended in Quality Criteria for Water as the allowable limit for a receiving stream from a toxicity standpoint. Additional information can be found in Volume V, Appendix F of MMSD's facilities plan.

(a6) Residual Chlorine

This alternative includes dechlorination of the effluent to the level which would provide the value recommended in Quality Criteria for Water for protection of the receiving stream. Refer to the summary plan, page 8-16 and Volume V, Appendix F of the facilities plan for additional information.

(a7) Heavy Metals

It would appear from MMSD's analysis of heavy metals data, that the treatment processes (such as effluent filtration and equalization) provided in this alternative will minimize the maximum concentrations of the various heavy metals occurring in the effluent. Although the effluent may ultimately contain higher than recommended levels of certain heavy metals, discharge of the effluent is not expected to have a significant effect on the aquatic environment.

As an added measure beyond the treatment processes provided, MMSD will attempt to locate the sources of these metals in order to eliminate them. Additional information on this subject can be found in Section 3 of the summary plan and Volume V, Appendix F of the facilities plan.

(a8) Cyanides

The various treatment processes provided in this alternative (such as biological nitrification and filtration) are expected to effectively remove cyanides to below toxic levels. In addition MMSD will also attempt to identify sources of cyanides to achieve additional removals. Additional information can be found in the summary plan, page 8-21 and Volume V, Appendix F of the facilities plan.

(a9) Pesticides and Polychlorinated Biphenyls (PCB's)

Pesticides and PCB's appear to be a potential problem area which cannot be fully defined without further investigations including collection of data on the receiving stream and location of sources in the sewer system to determine control programs. The filtration provided as a treatment process is expected to decrease the levels of these substances in the effluent. The source control program would further minimize those levels. All three alternatives are considered equal in respect to pesticide and PCB levels. Refer to the summary plan, Section 8 and Volume V, Appendix F of the facilities plan for additional information.

(b) Impact on Water Balance in Area Streams

Discharge of MMSD's effluent to the Yahara River south of Stoughton would not divert the flow completely out of the Yahara River basin. As indicated in MMSD's environmental assessment, page 3-20, low flows in the upper Yahara River are expected to recede as diversion out of the sub-basin continues and as water usage increases with the growing population. MMSD's facilities plan recommends a program to augment the flow in the Yahara River during critical periods which involves the control of the levels of the Madison Lakes and utilization of portions of the lake water for flow augmentation. Since the MMSD flow is not diverted completely out of the upper Yahara River basin in this alternative, flow augmentation requirements would be minimized. Refer to Volume V, Appendix C of MMSD's facilities plan for additional information.

(c) Impacts on Use of Surrounding Lands

The impacts of this alternative on the use of surrounding lands would be related primarily to effluent discharge volume. The hydraulic modeling of the Yahara River, conducted as part of MMSD's facilities planning and included in Volume V, Appendix H of the plan, indicates that discharge to the Yahara River would represent only a very small increase in predicted flood flow volumes. Therefore, the impact of discharge of the effluent would be virtually non-existent in this stream.

(d) Impact on Air Quality

It is estimated that the impact of the expanded treatment plant on the air quality of the area will be negligible. Whatever small impact is present will be in a positive direction since the upgrading of the treatment plant and the effluent quality will result in the potential release of less odor into the air than at present.

The discharge of the effluent to the Yahara River would have no adverse impacts on the air quality of the surrounding areas as the improved treatment would insure that aerobic conditions would be consistently met.

(e) Impact on Energy Consumption

This alternative would have a definite impact on the amount of energy consumed for the treatment and disposal of sewage in the Madison area.

Current annual energy consumption for wastewater treatment and disposal, as shown in Volume IV, Appendix A of MMSD's facilities plan, is summarized in Table 3-2.

Table 3-3 shows the anticipated annual electrical energy consumption for wastewater treatment and discharge associated with Alternative #1 (Yahara River Alternative).

Table 3-2
Approximate Annual Electrical
Energy Consumption MMSD - 1975

Wastewater Collection	Wastewater Treatment	Effluent Pumping	TOTAL
5.3	5.5	8.2	19.0

Table 3-3
Anticipated MMSD Electrical Power
Consumption for Alternative #1

(Yahara River Alternative)

(KWH x 10^6)

Present Usage		Estimated Additional Future Usage		Total Future Usage
Treatment	Effluent Pumpage	Treatment	Effluent Pumpage	
5.5	8.2	28.3	3.8	45.8

1. Estimated from 1975 utility billings

2. Includes power consumption estimates for Fifth Addition, other necessary secondary treatment plant upgrading and advanced wastewater treatment

Source: MMSD's Environmental Assessment, Table 3-10, page 3-25.

e. Evaluation of Systems Reliability:

Treatment Plant Reliability - The proposed treatment facilities are expected to be reliable as long as they are properly designed, operated and maintained. The proposed equalization facility would prevent shock loadings to the receiving stream resulting from peak loadings or possible equipment failures. Backup power sources are essential for the reliability of the treatment plant.

Pump Station Reliability - The pump stations are expected to be sufficiently reliable as long as it is properly operated and maintained.

Pipeline Reliability - The pipeline is expected to be sufficiently reliable as long as it is properly designed, installed, and maintained.

f. Evaluation of System's Flexibility:

Flexibility for Higher Flows and Higher Influent Load - Flexibility from this standpoint was built into all alternatives considered for treatment facilities and for discharge facilities including the Yahara River alternative.

Flexibility for Higher Effluent Quality - Flexibility from this standpoint was also built into all alternatives considered. This alternative, which provides advanced treatment, will facilitate meeting higher water quality goals if standards become more stringent.

3. Alternative #2 - Split Discharge to Badfish Creek and Yahara River

a. Description of Alternative:

(1) Transmission Facilities and Routing

A constant volume of approximately 35 MGD would be discharged to the Badfish Creek and additional effluent volumes (15-40 MGD) would be pumped to the Yahara River.

For pumping to the Badfish Creek portion of this alternative the existing 54" force main would be utilized to transmit the effluent. The impellers of the existing effluent pumps would be replaced with new 29-1/4" diameter impellers. The existing effluent ditch is adequate to handle the projected flow increase to the year 2000. However, portions of the ditch would be fenced to alleviate possible safety hazards in areas where residential growth has taken place since the construction of the ditch. In addition to the fencing, the entire ditch and creek would be examined for possible improvements to any areas where erosion and/or tree growth are causing any problems.

To pump the portion of the flow to the Yahara River a new 48 inch force main would be installed from the present outfall to the point of discharge south of Stoughton (the same route as for Alternative #1). At the present outfall a booster station having four 200-hp variable speed motors would be required to pump the portion of flow to the Yahara River. A second source of power for the booster station would not be required since in case of a power outage the entire flow could be discharged to the Badfish Creek for the duration of the power outage.

These routes can be seen on Figures 3-1 and 3-2. That figure does not, however, show the entire effluent ditch to Badfish Creek.

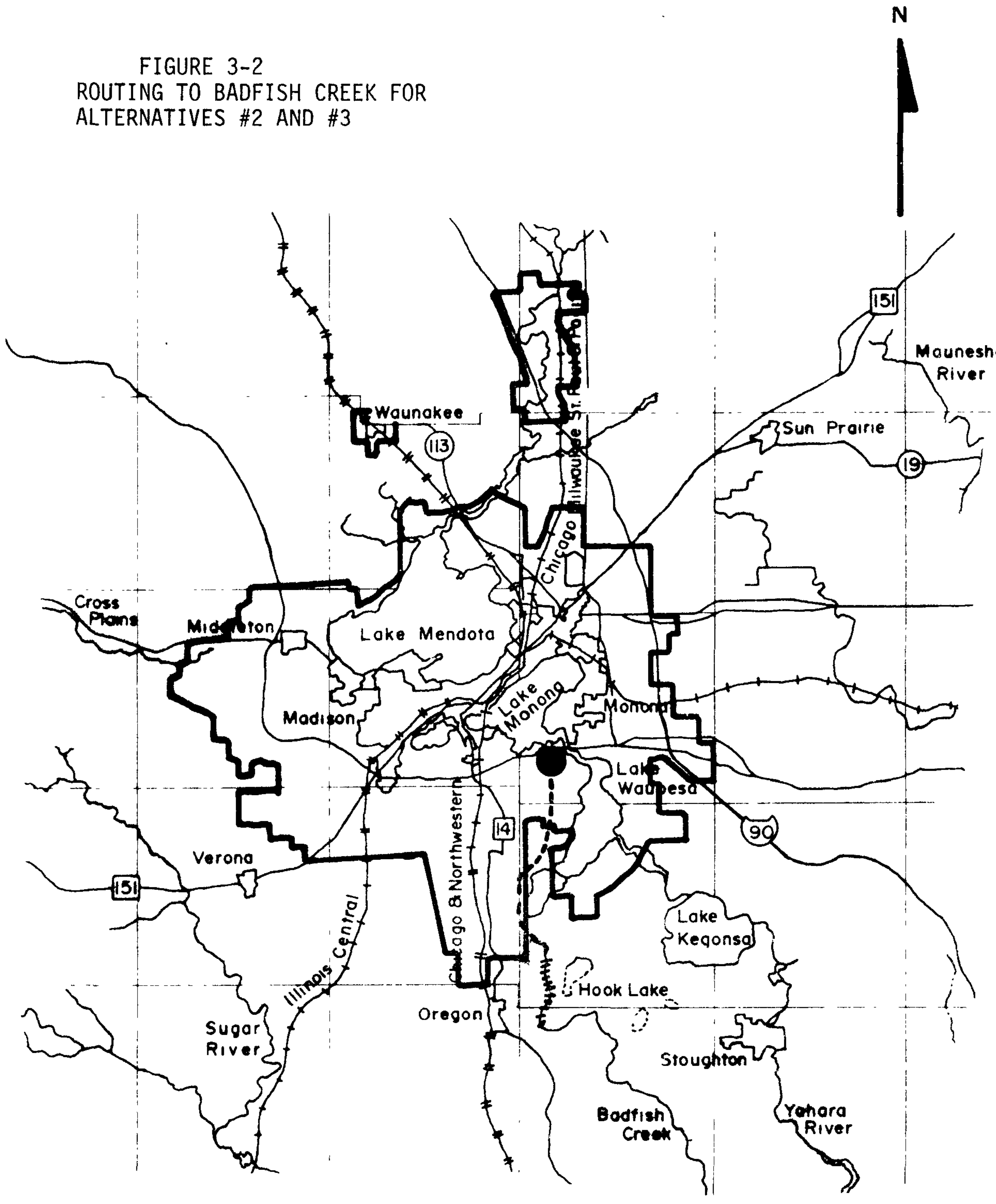
(2) Effluent Quality Limitations

The effluent quality limitations which, of necessity, apply to this split discharge system alternative are for the stream having the stricter requirements. Therefore, the effluent limitations proposed for discharge to the Yahara River apply for this split discharge. Refer to the section on Alternative #1 effluent limitations for discussion of these limits. These limits are defined as "Effluent II" in MMSD's facilities plan.

(3) Treatment Facilities

The same treatment facilities which would be required for the Yahara River alternative (Alternative #1) would be required for this alternative. Refer to the previous section on treatment facilities for Alternative #1 for a discussion of the treatment facilities required for "Effluent II". Since we feel that MMSD's analysis of treatment systems for this alternative is satisfactory, their selected treatment system for Effluent II has been assumed in this treatment-discharge alternative system.

FIGURE 3-2
ROUTING TO BADFISH CREEK FOR
ALTERNATIVES #2 AND #3



ALTERNATIVES #2 AND #3 UTILIZE
EXISTING PIPELINE AND EFFLUENT
DITCH TO BADFISH CREEK
ALTERNATIVE #2 ALSO INVOLVES
DISCHARGE TO YAHARA RIVER
AS SHOWN ON FIGURE 3-1

● – NINE SPRINGS WASTEWATER TREATMENT PLANT

++++++++ – EFFLUENT DITCH

– – – – – EFFLUENT PIPELINE

SOURCE: MMSD FACILITIES PLAN

O'BRIEN & GERE ENGINEERS, INC

b. Present-Worth Cost of Alternative #2 (Split Discharge to Badfish Creek and Yahara River:

The following cost summary is from Section 8 of the Summary Plan and Section 3 of the environmental assessment. Additional information on the development of cost estimates can be found in Volume II and Volume V, Appendix F of the facilities plan. More detailed breakdowns of these costs are provided in Appendix A, Tables A-1 and A-3 of this EIS.

Effluent Treatment	$42,590,000
Effluent Pumping	5,953,000
Transmission	5,661,000
Total Present Worth	$54,204,000

c. Evaluation of System's Ability to Meet Receiving Stream Water Quality Goals and Objectives:

This split discharge alternative would be expected to have impacts on the Yahara River and Badfish Creek similar to the total discharge of this quality effluent ("Effluent II") to each stream.

As pointed out in the section evaluating Alternative #1, the modeling completed as part of MMSD's facilities planning indicates that with the discharge of effluent to the Yahara River during low flow conditions, the dissolved oxygen level would be improved slightly due to the higher aeration rate induced by the increased flow. It would not, however, increase the D,O. to the 5 mg/l level at all times.

The modeling also indicates that the discharge of the effluent, with reaeration at the point of discharge to Badfish Creek, is anticipated to provide for the maintenance of D.O. levels above 5 mg/l during low flow conditions.

The receiving stream water quality goals and objectives for the Yahara River are for the full protection of fish and aquatic life and recreation use. The goals and objectives for the Badfish Creek as proposed by the Wisconsin Department of Natural Resources are for protection of recreation and for an intermediate level of fish and aquatic life. Alternative #2 cannot provide full protection for fish and aquatic life in the Yahara River because of background conditions. However, this alternative will fully protect fish and aquatic life and recreation in Badfish Creek. The standards for discharge to Badfish Creek will be evaluated in the section related to Alternative #3.

d. Evaluation of System's Environmental Impact:

(1) Impacts Resulting from Treatment Plant and Pump Station Construction

The impacts of these activities would be virtually the same for this alternative as for Alternative #1. There would be additional minor impacts resulting from booster station construction. Refer to Section D2d(1) of this EIS for the discussion of the impacts resulting from these activities.

(2) Impacts Resulting from Pipeline Installation and Effluent Ditch Usage

Although this alternative would involve installing a smaller size force main to the Yahara River than for Alternative #1, the impacts could be expected to be relatively the same as for that alternative. Refer to Section D2d(1) of this EIS for discussion of the impacts resulting from these activities. The impacts related to continued use of the effluent ditch which are discussed in that section would apply to this alternative. Alternative #1 would not have those effects since the effluent ditch would not be utilized in that system.

(3) Impacts Resulting from Operation of the Expanded Treatment Plant and Pumping and Transmission Facilities fro Split Discharge to Badfish Creek and the Yahara River

(a) Impact on Water Quality

The potential impacts on water quality resulting from operation of the expanded facilities are related primarily to the quality and volume of effluent discharge to Badfish Creek and to the Yahara River in this split discharge alternative.

The following sections describe the anticipated impact on various water quality parameters in these two receiving streams.

(al) Dissolved Oxygen

As discussed previously, the Yahara River below the Madison Lakes currently has widely varying dissolved oxygen values with projected minimum values falling well below the 5 mg/l level. This results from the photosynthetic and respiration activity of the phytoplankton present in the stream. The modeling performed is part of MMSD's facilities planning indicates that with the discharge of effluent to the Yahara River during low flow conditions, the D.O. level would be improved slightly due to the higher reaeration rate induced by the increased flow. It would not, however, increase the D.O. to the 5 mg/l level at all times.

The facilities planning modeling indicates that the discharge of the Nine Springs effluent, with reaeration at the point of discharge to the Badfish Creek, is anticipated to provide for the maintenance of D.O. levels above 5 mg/l during low flow conditions.

(a2) Suspended Solids

The various treatment processes (such as filtration) included in this alternative would provide a high level of protection for the aquatic community from the standpoint of effects of suspended solids. All discharge alternatives are considered equal in this respect.

(a3) Temperature

The MMSD effluent temperature is expected to increase slightly due to the advanced treatment processes. Discharge to an essentially warm water stream such as the Yahara River is not expected to significantly affect the stream. Continued discharge of a portion of the flow to the Badfish Creek is not expected to materially change the temperature of the stream from present conditions. Based on the study presented in Appendix E of the facilities plan it would appear that continuation of the present relatively high winter temperatures in Badfish Creek could continue to affect insect fauna by interfering with physiological processes that are temperature dependent. Additional information can be found in Volume IV, Appendix E and Volume V, Appendix F of MMSD's facilities plan.

(a4) Total Dissolved Solids

The total dissolved solids levels in Badfish Creek would be expected to remain the same as present levels and would not be expected to have any significant effect on the aquatic community.

The total dissolved solids levels in the Yahara River above its confluence with Badfish Creek could be expected to increase if a portion of Nine Springs effluent would be discharged to that river segment. However, it is not expected to have any significant effect on the aquatic community.

Additional information can be found in the summary plan, page 8-4 and Volume IV, Appendix E and Volume V, Appendix F of MMSD's facilities plan.

(a5) Ammonia Nitrogen

This alternative would provide an effluent containing a monthly average of 1 mg/l ammonia nitrogen during critical summer conditions to meet the stricter limit for discharge to the Yahara River. This would provide for a level of 0.02 mg/l un-ionized ammonia nitrogen in the Yahara River and Badfish Creek during critical summer conditions which is recommended in <u>Quality Criteria for Water</u> as the allowable limit for a receiving stream from a toxicity standpoint. Additional information can be found in Volume V, Appendix F of the facilities plan.

(a6) Residual Chlorine

This alternative includes dechlorination of the effluent to the level which would provide the value recommended in Quality Criteria for Water for protection of the receiving stream. Refer to the summary plan, page 8-16 and Volume V, Appendix F of MMSD's facilities plan for additional information.

(a7) Heavy Metals

It would appear from MMSD's analysis of heavy metals data that the treatment processes (such as effluent filtration and equalization) provided in this alternative will minimize the maximum concentrations of the various heavy metals occurring in the effluent. Although the effluent may ultimately contain higher than recommended levels of certain heavy metals, discharge of the effluent is not expected to have a significant effect on the aquatic environment. As an added measure beyond the treatment processes provided, MMSD will attempt to locate the sources of these metals in order to eliminate them.

This alternative differs from the other two because the potential heavy metals loading would be divided between two receiving streams. Additional information on this subject can be found in Section 3 of the summary plan and Volume V, Appendix F of MMSD's facilities plan.

(a8) Cyanides

The various treatment processes provided in this alternative (such as biological nitrification and filtration) are expected to effectively remove cyanides to below toxic levels. In addition MMSD will also attempt to identify sources of cyanides to achieve additional removals. Additional information can be found in the summary plan, page 8-21 and Volume V, Appendix F of the facilities plan.

(a9) Pesticides and Polychlorinated Biphenyls (PCB's)

Pesticides and PCB's appear to be a potential problem area which cannot be fully defined without further investigations including collection of data on the receiving stream and location of sources in the sewer system to determine control programs. The filtration provided as a treatment process is expected to decrease the levels of these substances in the effluent. The source control program would further minimize those levels. All three alternatives are considered equal in respect to pesticides and PCB levels. Refer to the Summary Plan, Section 8 and Volume V, Appendix F of the facilities plan for additional information.

(b) Impact on Water Balance in Area Streams

This alternative would provide some flow to the upper Yahara River Basin. Therefore, it would have the same beneficial impact on water balance as total discharge to the Yahara River (Alternative #1), only to a lesser degree. Greater flow augmentation provided by management of Madison lake levels would be required for this alternative as compared to that required for Alternative #1.

(c) Impact on Use of Surrounding Lands

As for total discharge to the Yahara River (Alternative #1), the impact of discharge of part of the effluent to the Yahara River would be virtually non-existent because it would represent only a very small increase in predicted flood flow volumes.

Discharging a constant flow of 35 MGD to Badfish Creek is similar to present flow levels and is not expected to significantly impact the use of surrounding lands.

(d) Impact on Air Quality

It is estimated that operation of the expanded facilities and discharge to Badfish Creek and the Yahara River would provide improved air quality with less odor problems in the vicinity of the treatment plant and receiving waters.

(e) Impact on Energy Consumption

This alternative would have a definite impact on the amount of energy consumed for the treatment and disposal of sewage in the Madison area. Refer to Table 3-2 in this EIS for current annual energy consumption for treatment and disposal. Table 3-4 shows the anticipated annual electrical energy consumption for wastewater treatment and discharge associated with Alternative #2 (Split discharge to Badfish Creek and Yahara River).

Table 3-4
Anticipated Electrical Power
Consumption for Alternative #2

(Split Discharge Alternative)

(KWH x 10^6)

Present Usage		Estimate Additional Future Usage		Total Future Usage
Treatment	Effluent Pumpage	Treatment	Pumpage	
5.5	8.2	28.3	3.9	45.9

1. Estimated from 1975 utility billings.

2. Includes power consumption estimates for Fifth Addition, other necessary secondary treatment upgrading and advanced wastewater treatment.

Source: MMSD's Environmental Assessment, Table 3-10, page 3-25.

e. Evaluation of System's Reliability:

Treatment Plant Reliability - The proposed treatment facilities are expected to be reliable as long as they are properly designed, operated and maintained. The proposed equalization facility would prevent shock loadings to the receiving stream resulting from the effect of peak loadings or possible equipment failures. Backup power sources are essential for the reliability of the treatment plant.

Pipeline Reliability - The pipeline is expected to be sufficiently reliable as long as it is properly designed, installed and maintained.

f. Evaluation of System's Flexibility:

Flexibility for Higher Flows and Higher Influent Load - Flexibility from this standpoint was built into all alternatives considered for treatment facilities and for discharge facilities including this split discharge alternative.

Flexibility for Higher Effluent Quality - Flexibility from this standpoint was also built into all alternatives considered. This alternative which provides advanced treatment facilities will facilitate meeting higher water quality goals if standards become more stringent.

4. Alternative #3 - Discharge to Badfish Creek

a. Description of Alternative:

(1) Transmission Facilities and Routing

This alternative would utilize the existing 54 inch force main and effluent ditch to transmit the effluent to Badfish Creek. This route can be seen on Figure 3-2. Flow equalization would be provided to limit the peak flow to 75 MGD. The existing effluent ditch is adequate to handle the projected flow increase to the year 2000. However, portions of the ditch will be fenced to alleviate possible safety hazards in areas where residential growth has taken place since the construction of the ditch. In addition to the fencing specified, the entire ditch and Creek will be examined for improvements to any areas where erosion and/or tree growth are causing any problems.

(2) Effluent Quality Limitations

Subsequent to the completion of MMSD's facilities plan, the Wisconsin Department of Natural Resources proposed effluent quality limitations for discharge of the effluent from Nine Springs STP to Badfish Creek. As indicated previously in this chapter, the WDNR final effluent limitations vary from those used in MMSD's facilities plan. The major difference is in the less stringent ammonia nitrogen level allowed in the effluent. This alternative utilizes the effluent quality limitations proposed by the WDNR, which are shown on Table 3-1.

(3) Treatment Facilities

For this alternative we have accepted MMSD's analysis of treatment processes in their facilities plan. However, the recently proposed WDNR effluent limitations require some alterations to the treatment system proposed in the facilities plan. Since the allowable total nitrogen level in the effluent to be discharged to Badfish Creek is less strict than the level proposed in MMSD's facilities plan, the treatment facilities proposed in the facilities plan no longer appear appropriate for this discharge alternative. The less strict ammonia limit should allow a lower level of nitrification. This alternative will assume that biological nitrification would achieve satisfactory ammonia nitrogen removal levels without the need for breakpoint chlorination for additional ammonia removal as proposed in the facilities plan. This would also eliminate the need for dechlorination facilities. It is felt that adequate disinfection of bacteria and viruses could be accomplished by the the addition of ozonation facilities. Expanded secondary treatment, filtration and effluent equalization facilities previously proposed would be retained in this alternative.

If this treatment-discharge alternative is selected for implementation, MMSD would have to conduct additional studies to determine what modifications could be made to the treatment facilities originally proposed that would provide an effluent in conformance with WDNR proposed final effluent limitations. This EIS assumes that the facilities proposed in this section will meet WDNR proposed effluent limitations. In summary, this alternative assumes the provision of the following treatment facilities:

A. Upgraded Secondary Treatment
B. Rotating Biological Contactor Nitrification
C. Ozonation
D. Filtration
E. Effluent Equalization

b. Present-Worth Cost of Alternative #3 (Discharge to Badfish Creek):

The estimated cost of treatment facilities required for discharge to Badfish Creek, which were developed in MMSD's facilities plan, is no longer entirely appropriate since it is expected that the WDNR proposed effluent limitations will allow modifications to the treatment facilities as discussed in the previous section. Without the additional studies which MMSD would have to conduct if this alternative is selected for implementation, it is only possible at this time to provide an estimated range of costs for this alternative. The ultimate cost will be heavily dependent on whether biological nitrification would provide adequate ammonia nitrogen removal and to what extent the rotating biological contactor facilities would be reduced in capacity. Adding ozonation for disinfection could significantly increase operation and maintenance costs.

In order to be able to present an estimate of the cost of treatment facilities for this alternative in this EIS we requested that MMSD provide us with an estimate of how the WDNR proposed final effluent limitations might change the treatment facilities required for discharge to Badfish Creek and what the resultant change in cost might be. Without the benefit of the additional studies necessary to accurately estimate these changes, they provided us with a very rough estimate of potential changes. It appears from that information that the reduction in the present worth cost of treatment facilities for discharge to Badfish Creek may be negligible, or as much as $3,000,000. At the lower end of this range of costs there appears to be a possibility that certain modifications could decrease capital costs but increase operational costs to such an extent that there would be little net present worth savings. Without additional studies, however, this is highly conjectural.

The estimated cost of pumping and transmission for effluent discharge to Badfish Creek should not be changed from those developed in MMSD's facilities plan Volume V, Appendix F.

The following is a summary of the estimated costs of this alternative:

	Range
Effluent Treatment	\$39,590,000 - \$42,590,000
Effluent Pumping	4,325,000 - 4,325,000
Transmission	305,000 - 305,000
Total Present Worth	\$44,220,000 - \$47,220,000

As previously indicated only a rough estimate of effluent treatment costs can be presented in this EIS for this alternative. A more detailed breakdown of pumping and transmission costs can be found in Appendix A, Table A-4 of this EIS.

c. Evaluation of System's Ability to Meet Receiving Stream Water Quality Goals and Objectives:

The water quality goals and objectives which the Wisconsin Department of Natural Resources is proposing for Badfish Creek involve protection of recreation and an intermediate level of protection of fish and aquatic life. Information presented by MMSD in their facilities plan indicated that a level of effluent and resultant instream water quality suitable for protection of fish and aquatic life is attainable. The Wisconsin Department of Natural Resources based their proposed variance from meeting full protection of fish and aquatic life in the upper reaches of Badfish Creek on the fact that they felt that the fishery potential of the Creek is limited because of stream morphology and bottom characteristics.

It does not appear to this Agency that the documentation provided us by the WDNR is sufficient to justify the variance from meeting the goal of fully protecting fish and aquatic life in the upper reaches of Badfish Creek. At the same time, however, it does appear that full protection of fish and aquatic life may be achieved even with the less strict effluent limits proposed by the WDNR. From a cost standpoint it does not appear to be justified to recommend that MMSD provide the high level of nitrification proposed in their facilities plan without documentation of the incremental water quality improvement and increased potential for propagation of fish and aquatic life. If this alternative would be selected for implementation we would recommend, therefore, that the WDNR suspend the promulgation of a variance from full fish and aquatic life standards for the upper reaches of Badfish Creek; that the WDNR proposed effluent limits be used as the basis of design for the treatment facilities at Nine Springs STP; and that MMSD conduct bioassays and water quality monitoring in Badfish Creek prior to and subsequent to the operation of the new facilities to determine the impact of the new facilities and improved water quality on the aquatic life of Badfish Creek. Based on the results of those studies, a decision can then be made to grant a variance for the upper reaches of the Creek and/or to construct additional nitrification facilities. In addition, we would recommend that the proposed facilities be designed so that additional nitrification facilities could be provided at a later date if it is shown that they are necessary to adequately protect fish and aquatic life from ammonia toxicity.

d. Evaluation of System's Environmental Impact:

(1) Impacts Resulting from Treatment Plant and Pump Station Construction

The impacts resulting from these activities are expected to be virtually the same as for Alternative #1 except that Alternative #3 would not involve pump station construction. Refer to Section D2d(1) of this EIS for a discussion of the potential impacts resulting from these activities.

(2) Impacts Resulting from Pipeline Installation and Effluent Ditch Maintenance

(a) Impact on Water Quality

This alternative would not require a new pipeline. Therefore, the various construction impacts resulting from installation of a 57,000 foot, pipeline would be avoided such as those resulting from the other two alternatives.

The MMSD's current effluent ditch and creek maintenance technique of brush cutting in some sections appears to leave the banks relatively bare and subject to erosion in some locations. While this technique has the benefit of preventing flow obstruction, it would seem to have the potential to create water quality impacts because the removal of bank cover could increase water temperature. At the request of land owners along the ditch and creek, certain sections of the banks have been and may in the future be riprapped by MMSD to prevent bank erosion. This practice eliminates the erosion and sedimentation impact on water quality. However, the artificially structured character of the ditch and Creek are increased. These impacts related to maintaining the effluent ditch are minor compared to those related to installing the pipelines in the other alternatives.

(b) Impact on Use of Surrounding Lands

The existing discharge pipeline and effluent ditch were installed prior to the 1958 diversion of the effluent to Badfish Creek. Problems related to installation and use of the pipeline and ditch and appropriate mitigative action which have and could be taken to alleviate the problems were discussed in the section related to Alternative #1.

(c) Impact on Air Quality

Implementation of this alternative would not have the temporary adverse impact on air quality associated with increases in dust levels during pipeline installation, since this alternative does not require a pipeline.

(d) Impact on Energy Consumption

Since this alternative does not involve installation of a pipeline, it would not involve the consumption of the fuel to operate the vehicles and equipment required to install the pipeline.

(3) Impacts Resulting from Operation of the Expanded Treatment Facilities and Pumping and Transmission Facilities for Discharge to Badfish Creek

(a) Impact on Water Quality

The potential impacts on water quality resulting from operation of the expanded facilities would be related primarily to the quality and volume of effluent discharge to Badfish Creek.

The following sections describe the anticipated impact on various water quality parameters resulting from continued discharge to Badfish Creek.

(a1) Dissolved Oxygen

The mathematical modeling which the WDNR had performed subsequent to the completion of MMSD's facilities plan indicated that the proposed final effluent limitations would provide a minimum level of 5 mg/l in all reaches of the Creek at all times. This would be an improvement over existing conditions. Assuming ozonation is used for disinfection, the effluent may have a higher level of dissolved oxygen than the other alternatives provide. This would have to be substantiated by further study if this alternative would be selected.

(a2) Suspended Solids

The various treatment processes (such as filtration) provided in this alternative would provide a high level of protection for the aquatic community from the effects of suspended solids. All discharge alternatives are considered equal in this respect.

(a3) Temperature

It is anticipated that the treatment processes proposed in this alternative would result in a net increase in effluent temperature of one (1) to two (2) degrees and would not materially change the temperature of the stream from present conditions. Based on the study presented in Appendix E of the facilities plan it would appear that continuation of the present relatively high winter temperatures in Badfish Creek could continue to affect quantity and diversity insect fauna by interfering with physiological processes that are temperature dependent. Additional information can be found in Volume IV, Appendix E and Volume V, Appendix F of MMSD's facilities plan.

(a4) Total Dissolved solids

The total dissolved solids levels in Badfish Creek would be expected to remain the same as present levels and would not be expected to have any significant effect on the aquatic community. Additional information can be found in Volume IV, Appendix D and Volume V, Appendix F of MMSD's facilities plan.

(a5) Ammonia Nitrogen

This alternative would provide an effluent containing a monthly average of 1 mg/l ammonia nitrogen during critical summer conditions. The WDNR feels that this would provide for a level of 0.02 mg/l, un-ionized ammonia nitrogen in the critical downstream reaches of Badfish Creek during summer conditions. The level of 0.02 mg/l of un-ionized ammonia is recommended in <u>Quality Criteria for Water</u> as the allowable limit for a receiving stream from a toxicity standpoint. From the information available to this Agency, it appears this effluent ammonia nitrogen level would also result in an un-ionized ammonia level within this recommended limit in the upper reaches of Badfish Creek.

(a6) Residual Chlorine

This alternative assumes that breakpoint chlorination would be eliminated for additional ammonia removal and for disinfection. Dechlorination would also be eliminated. Ozonation would be used for disinfection. This would provide a high level of disinfection without any residual chlorine entering the Creek.

(a7) Heavy Metals

It would appear from MMSD's analysis of heavy metals data that the treatment processes (such as effluent filtration and equalization) provided in this alternative will minimize the maximum concentrations of the various heavy metals occurring in the effluent. Although the effluent may ultimately contain higher than recommended levels of certain heavy metals, discharge of the effluent is not expected to have a significant effect on the aquatic environment. As an added measure beyond the treatment processes provided, MMSD will attempt to locate the sources of these metals in order to eliminate them. Additional information on this subject can be found in Section 3 of the summary plan and Volume V, Appendix F of the facilities plan.

(a8) Cyanides

The various treatment processes provided in this alternative (such as biological nitrification and filtration) are expected to effectively remove cyanides below toxic levels. In addition, MMSD will also attempt to identify sources of cyanides to achieve additional removals. All alternatives are considered equal in respect to this parameter. Additional information can be found in the summary plan, page 8-21 and Volume V, Appendix F of the facilities plan.

(a9) Pesticides and Polychlorinated Biphenyls (PCB's)

Low levels of pesticides and PCB's were found in the Nine Springs secondary effluent and the concentrations were found to be in excess of the levels recommended for protection of fish and aquatic life. Low levels of pesticides were also found to be present in both the Rutland Branch of Badfish Creek and in Spring Creek.

Pesticides and PCB's appear to be a potential problem area which cannot be fully defined without further investigations including collection of data on the receiving stream and location of sources in the sewer system to determine control programs. The filtration provided as a treatment process is expected to decrease the levels of these substances in the effluent. The source control program would further minimize these levels.

Refer to the Summary Plan, Section 8 and Volume V, Appendix F of the facilities plan for additional information.

(b) Impact on Water Balance in Area Streams

As has been indicated previously, the diversion of the Nine Springs effluent around a portion of the Yahara River beginning in December 1958 has had a significant effect on the low flow conditions in that portion of the river. As water usage increases with the growing population, continued diversion of the effluent to the present discharge location, Badfish Creek, is expected to increase the effects on the low flow values. If diversion is continued and no mitigative action is taken, the flows may fall to zero as often as once in two years by the year 2000. This would limit the value of the stream for waste assimilation and other uses. More detailed information on this subject can be found in Volume IV, Appendix C of MMSD's facilities plan.

MMSD's facilities plan recommends a program to augment the flow in the Yahara River during critical periods which involves the control of the levels of the Madison Lakes and utilization of portions of the lake water for flow augmentation. Since this alternative involves continued diversion to Badfish Creek it would involve a much higher level of flow augmentation than either of the other alternatives. If no one takes the initiative to develop and implement the lake level management program this alternative would have a greater impact on low flow conditions in the Yahara River than the other two alternatives would have.

(c) Impact on Use of Surrounding Lands

As for the other alternatives, the impact of this alternative on the use of surrounding lands would be related primarily to effluent discharge volume.

Hydraulic modeling of Badfish Creek was conducted as part of MMSD's facilities planning. The detailed results can be found in Volume V, Appendix H of the facilities plan. The hydraulic modeling of the Badfish Creek indicated that the discharge of a projected effluent flow of 78 cfs would increase the flooding in the Creek for the once-in-two year and once-in-five year floods. Only minimal damages are expected to occur as the result of these floods. The once-in-ten year flood was predicted to top the level of the stream banks by three feet in some areas. Flood flows of the once-in-ten year flood would be limited to agricultural or uncultivated land adjacent to the Creek. The once-in-ten year flood flow is predicted to be 1,388 cfs. The effluent flow of 78 cfs represents only 5.6% of the total flow. During periods of flood flows of less frequency, the effluent would represent even a smaller percentage of the total flow volume.

Although continued discharge of the total Nine Springs effluent to Badfish Creek is not expected to impact the use of surrounding lands to a significant extent, it would have a greater impact in this respect than the other two alternatives.

(d) Impact on Air Quality

Operation of the expanded facilities and discharge to Badfish Creek should provide improved air quality with less odor problems in the vicinity of the treatment plant because of the improved treatment provided.

(e) Impact on Energy Consumption

This alternative would have a definite impact on the amount of energy comsumed for the treatment and disposal of sewage in the Madison area.

This alternative may result in more electrical energy consumption than Alternatives #1 and 2 if ozonation replaces breakpoint chlorination; however, that would be dependent on what total modifications would be recommended after additional study is made.

Current annual energy consumption for wastewater treatment and disposal, as shown in Volume IV, Appendix A of MMSD's facilities plan, were summarized in Table 3-2 of this EIS.

Until further studies are completed the future annual electrical energy consumption for wastewater treatment and discharge associated with Alternative #3 (Badfish Creek Alternative) will be assumed to be equivalent to that estimated for the Badfish Creek Alternative without modification and shown on Table 3-5.

Table 3-5
Anticipated Electrical Power
Consumption for Alternative #3
(Badfish Creek Alternative)

(KWH x 10)

Present Use		Estimated Additional Future Use		Total Future Use
Treatment	Effluent Pumpage	Treatment	Effluent Pumpage	
5.5	8.2	28.3	3.7	45.7

1. Estimated from 1975 utility billings

2. Includes power consumption estimates for Fifth Additon, other necessary secondary treatment upgrading and advanced wastewater treatment.

Source: MMSD's Environmental Assessment, Table 3-10, page 3-25.

e. Evaluation of System's Reliability:

Treatment Plant Reliability - The proposed treatment facilities for this alternative assume that biological nitrification will be all that is required to meet the WDNR effluent standards for discharge to Badfish Creek. Discussions with MMSD and its consultant indicated that the proposed effluent limit for ammonia to meet critical conditions is on the borderline of what can be met with only biological nitrification. If this alternative is adopted, additional study must be completed by MMSD to determine how the plans can be modified and meet the effluent limitation. If this alternative is adopted, we plan to recommend to MMSD that they monitor ammonia levels in all reaches of Badfish Creek and complete bioassays to determine the effect of these ammonia levels on fishes in the Creek. If the results indicate that a higher level of ammonia removal is necessary, then appropriate nitrification facilities, such as breakpoint chlorination, could be installed at that time. The treatment facilities are expected to be reliable as long as they are properly designed, maintained and operated. The proposed equalization facility would prevent shock loadings to the stream resulting from peak loadings or possible equipment failures. Backup power sources are essential for the reliability of the treatment plant.

Pump Station Reliability - The pump station is expected to be sufficiently reliable as long as it is properly operated and maintained.

Pipeline Reliability - The existing pipeline has been reliable in the past. With proper maintenance it is expected to continue to be reliable.

f. Evaluation of System's Flexibility:

Flexibility for Higher Flows and Higher Influent Load - Flexibility from this standpoint was built into all alternatives.

Flexibility for Higher Effluent Quality - Flexibility from this standpoint was also built into all alternatives considered. This alternative which provides advanced treatment facilities will facilitate meeting higher water quality goals if standards become more stringent. Although the level of ammonia removal will not be as high as for the other alternatives, the system will be designed to allow for provision of additional nitrification facilities if required at a future date.

E. COMPARISON OF FINAL TREATMENT-DISCHARGE ALTERNATIVES

1. Comparison of Present-Worth Cost of Treatment-Discharge Alternatives

Table 3-6
Comparison of Present-Worth
Costs of Alternatives #1-3

	Alternative #1 Yahara River	Alternative #2 Split Discharge Badfish-Yahara	Alternative #3 Badfish Creek Range*
Effluent Treatment	$42,590,00	$42,590,000	$39,590,000 - $42,590,000
Effluent Pumping	5,085,000	5,953,000	4,325,000
Transmission	9,548,000	5,661,000	305,000
Total Present Worth	$57,223,000	$54,204,000	$44,220,000 - $47,220,000

*The costs for Alternative #3 can only be given as a range of costs. If this alternative is selected for implementation, additional studies would be completed which would better define these costs.

As can be seen in Table 3-6, Alternative #3 (discharge to Badfish Creek) would be substantially less expensive than the other two alternatives. Alternative #2 (split discharge) would be the next least costly system and Alternative #1 (Yahara River discharge) would be most costly. The most significant cost difference is for the transmission facilities. Alternative #3 would utilize the existing pipeline and effluent ditch. The treatment facilities for Alternative #3 may be less costly than for the other alternatives, however, that difference cannot be defined without further study. Less treatment costs for Alternative #3 would only heighten the already substantial cost difference between that alternative and the others.

2. Comparison of Ability of Alternatives to Meet Receiving Stream Water Quality Goals and Objectives

Alternative #1 (Yahara River) - Even with the high level of treatment proposed for this alternative, the Yahara River is not expected to consistently meet the standards for full protection of fish and aquatic life.

Alternative #2 (Split discharge-Badfish, Yahara) - As with Alternative #1, even with the high level of treatment proposed, the Yahara River is not expected to meet the standards for full protection of fish and aquatic life because of background conditions. Full protection of fish and aquatic life would be provided in Badfish Creek.

Alternative #3 (Badfish Creek) - The effluent in this alternative would meet the limits proposed by the Wisconsin Department of Natural Resources. D.O. standards for full protection of fish and aquatic life are expected to be met in all reaches of Badfish Creek. It is expected that the standard for full protection of fish and aquatic life from an ammonia toxicity standpoint would be met in reaches of the Creek.

3. Comparison of Environmental Impacts Resulting from the Final Treatment - Discharge Alternatives

a. Impacts Resulting from Treatment Plant and Pump Station Construction:

There would be no major difference between alternatives resulting from these activities.

b. Impacts Resulting from Pipeline Installation and Effluent Ditch Maintenance:

Alternatives #1 and #2 involve the construction of an additional pipeline and would therefore not involve the same large commitment of resources and temporary construction.

Alternatives #2 and #3 involve continued maintenance of the effluent ditch and Badfish Creek to prevent flow obstruction and erosion and sedimentation. This will perpetuate the artificially structured character of the ditch and Creek and may tend to increase water temperature.

c. Impacts Resulting from Operation of the Expanded Treatment Plant and Pumping and Transmission Facilities:

(1) Comparison of Water Quality Impacts

(a) Dissolved Oxygen

Alternative #3 with total discharge to Badfish Creek is the only alternative expected to consistently meet all applicable receiving water quality standards for dissolved oxygen. Alternative #1, involving discharge to the Yahara River, is not expected to consistently meet dissolved oxygen standards. Alternative #2, involving a split discharge to the Yahara River and to Badfish Creek, is not expected to meet dissolved oxygen standards in the Yahara River, but is expected to meet dissolved oxygen standards in the Badfish Creek.

(b) Suspended Solids

All three alternatives are considered to be equal in this respect.

(c) Temperature

Alternative #1 is not expected to significantly affect the Yahara River from a temperature standpoint. Alternative #1 would probably decrease the net temperature of the Badfish Creek since it would involve diversion of the effluent out of the Creek. However, it is felt that other factors would be more significant in controlling the type of organisms which could exist in the Creek if the effluent were diverted. Alternative #2 would divide any potential temperature impacts between the two receiving streams. Its impact on the temperature of Yahara River is expected to be insignificant. It is expected to perpetuate existing warm water temperature conditions in the Badfish Creek which are suspected of impacting the insect fauna. Alternative #3 is also expected to perpetuate existing temperature conditions in Badfish Creek.

(d) Total Dissolved Solids

There is no significant difference between alternatives with respect to total dissolved solids.

(e) Ammonia Nitrogen

All three alternatives are expected to meet recommended limits for protection of aquatic life from a toxicity standpoint.

(f) Residual Chlorine

Alternative #3 is assumed to include ozonation for disinfection and would therefore have no potential for residual chlorine toxicity. Although Alternatives #1 and #2 are expected to maintain an effluent which would provide levels of residual chlorine in the receiving stream within recommended levels, they would still have the potential for causing toxicity to aquatic organisms if the system is not properly managed.

(g) Heavy Metals, Pesticides and PCB's, Cyanides

There does not appear to be a significant difference between alternatives with respect to these water quality impact parameters.

(2) Impact on Water Balance in Area Streams

There is a significant difference between the three alternatives related to the potential impact on the water balance in area streams. Alternative #1 would require the least flow augmentation in the upper Yahara River. Alternative #2 would require more flow augmentation in the upper Yahara River than would Alternative #1. Alternative #3 would require the most flow augmentation in the upper Yahara River. Mitigation of the potential impacts of these alternatives on water levels in the upper Yahara River is dependent on the development and implementation of a lake level management program for the Madison lakes to augment the flow of the upper Yahara River. If no one takes responsibility for initiating such a program and it is not instituted, the potential impacts can be expected to vary according to the treatment-discharge alternative. Such a program will require a comprehensive cooperative effort of Madison area agencies.

(3) Impact on Use of Surrounding Lands

Alternative #3 is expected to increase the flooding in Badfish Creek for the once-in-two-year and once-in-five-year floods. The area which would be flooded would be limited to agricultural and uncultivated land adjacent to the Creek and is expected to cause minimal damage and minimal impact on use of surrounding lands. During flood flows of less frequency, such as for once-in-ten-year floods, the effluent would not be a significant portion of the total flow volume.

Alternatives #1 and #2 are not expected to have a significant effect on the use of lands surrounding the receiving stream(s).

(4) Impact on Air Quality

There does not appear to be a significant difference between alternatives with respect to this parameter.

(5) Impact on Energy Consumption

All three alternatives are expected to increase the amount of energy consumed by the MMSD. Using the best estimates available at this time, we can only conclude that there would not be a significant difference in the energy consumed by the three alternatives. However, as pointed out previously, Alternative #3 may require more electrical energy for treatment plant operation than would the other alternatives if ozonation replaces breakpoint chlorination for disinfection. The total amount of additional energy required would be dependent on what total modifications would be recommended after additional study.

4. Comparison of System Reliability of the Final Treatment-Discharge Alternatives

There does not appear to be any significant difference between the final discharge alternatives in terms of treatment system reliability.

5. Comparison of System Flexibility of the Final Treatment-Discharge Alternatives

Flexibility for higher flows, higher influent load and higher effluent quality was built into all alternatives.

F. SUMMARY COMPARISON OF FINAL ALTERNATIVES AND SELECTION OF THE PROPOSED ACTION

The most significant differences between the three final alternatives and the "no action" alternative were found to be in the following categories which are displayed on Table 3-7:

1. PRESENT-WORTH COST

2. ABILITY TO MEET RECEIVING STREAM WATER QUALITY GOALS AND OBJECTIVES

3. ENVIRONMENTAL IMPACT

   a. Impacts Resulting from Operation of the Expanded Treatment Plant and Pumping and Transmission Facilities

      (1) Water Quality Impacts-Dissolved Oxygen and Ammonia Nitrogen

      (2) Impact on Water Balance in Area Streams

As a result of the comparison of final alternatives, Alternative #3 with discharge to Badfish Creek has been selected as the proposed action. Alternative #3 is significantly less costly than the other alternatives primarily because it does not involve construction of a new pipeline. We feel that Alternative #3 comes closest to meeting all applicable water quality goals for the receiving stream(s). Alternative #3 will not create the impacts resulting from construction of a pipeline to the Yahara River. While Alternative #3 does have the the greatest flow augmentation requirement in the upper Yahara River, MMSD has proposed a program to mitigate the potential base flow recession impacts. It is recommended that MMSD cooperate with other area agencies in assuring that such a program is implemented.

CHAPTER 4
DESCRIPTION OF PROPOSED ACTIONS

The proposed action involves expansion of the existing facilities and construction of advanced waste treatment facilities at Madison Metropolitan Sewerage District's Nine Springs Sewage Treatment Plant. The effluent from this plant will be transmitted via the existing pipeline and effluent ditch to Badfish Creek (Refer to Figure 3-2).

Section nine (9) of MMSD's Summary Plan and Section four (4) of their environmental assessment (In Volume II of this EIS) describe the proposed actions. As indicated previously, the alternative for discharge to Badfish Creek was modified subsequent to MMSD's completion of their facilities planning. The Wisconsin Department of Natural Resources proposed final effluent limitations for discharge to Badfish Creek which varied from those assumed in MMSD's facilities plan and which served as the basis of design of the treatment facilities. Therefore, the actions proposed in this EIS vary somewhat from those described in the summary plan and environmental assessment. The following paragraphs will summarize how the proposed actions in this EIS vary from the actions proposed in Section nine (9) of the summary plan and Section four (4) of the environmental assessment.

The discussion of sludge treatment and handling facilities presented in the summary plan and environmental assessment should be considered as information only since it was the subject of a previous EIS.

Since the allowable total ammonia nitrogen level in the effluent to be discharged to Badfish Creek is less stringent than the level proposed in MMSD's facilities plan, the treatment facilities proposed in the plan no longer appear entirely appropriate for this discharge alternative. This ammonia limit should allow a lower level of nitrification. This alternative will assume that biological nitrification will achieve satisfactory ammonia nitrogen removal levels without the need for breakpoint chlorination for additional ammonia removal as proposed in the facilities plan. This would also eliminate the need for dechlorination facilities. It is felt that adequate disinfection of bacteria and viruses could be accomplished by the addition of ozonation facilities. Expanded secondary treatment, filtration and effluent equalization facilities previously proposed would remain as part of the proposed actions.

Table 9-1 of Section nine (9) of the summary facilities plan, which presents the basis of design for the advanced waste treatment facilities, is not entirely appropriate to describe the basis of design for the proposed action. The secondary effluent characteristics, tertiary filter basis of design, and anticipated pumped effluent characteristics are expected to vary from that presented in Table 9-1. However, the changes will not be known until further study is completed. Breakpoint chlorination and dechlorination have been eliminated and substituted with ozonation for disinfection. The basis of design for ozonation will not be known until further study is completed.

Table 9-3 and 9-4 will change depending on when a project is implemented and on the results of further studies. The most up-to-date cost of the proposed project were discussed in Chapter three(3) of this EIS.

The proposed changes to the treatment facilities previously discussed make portions of Section 9.02 obsolete. In addition to the changes previously discussed Section 9.02D should be disregarded since we have eliminated the option of possible discharge to the proposed Koshkonong Nuclear Power Plant at this time as was discussed in Chapter three (3) of this EIS.

Section four (4) of MMSD's environmental assessment is basically a summary of Section nine (9) of the summary plan. Therefore, the same basic changes apply. Table 4-1 is now obsolete. The proposed facilities would be designed to meet the WDNR proposed effluent limits discussed in Chapter three (3) of this EIS.

CHAPTER 5
ENVIRONMENTAL IMPACT OF THE PROPOSED ACTIONS

A. INTRODUCTION

The impacts which would occur would primarily be the result of the following actions:

1. Treatment Plant Construction

2. Effluent Ditch Maintenance

3. Operation of the upgraded and expanded treatment facilities and continued use of the Pumping and Transmission Facilities which discharge to Badfish Creek.

Using the categories of existing environmental parameters discussed in Chapter 2 of this EIS we will evaluate the impact of the proposed actions on those parameters. In those cases where the impacts have been evaluated fully enough in MMSD's environmental assessment (EA) we will reference the appropriate sections of their assessment.

B. IMPACT ON CLIMATE

Section 5.01 A of MMSD's EA sufficiently evaluates potential impact on climatic factors.

C. IMPACT ON TOPOGRAPHY AND GEOLOGY

Potential impacts on topography are evaluated in Section 5.01 B of MMSD's EA. Impacts on geological structures and formations are not anticipated.

D. IMPACT ON SOILS

Potential impacts related to soils are discussed in Section 5.01 C of MMSD's EA.

E. IMPACT ON WATER RESOURCES

1. Impact on Water Quality Management and Planning

Impacts in this category would relate to whether or not the proposed actions are in compliance with water quality legislation policies, and planning.

Related to areawide water quality planning, the proposed actions are expected to be consistent with the Dane County 208 areawide water quality planning program and will be incorporated into the plan. In addition the proposed actions are compatible with other 201 facilities plans being conducted in the area.

The 1972 Amendments to the Federal Water Pollution Control Act, PL 92-500 have as an interim goal that water quality suitable for the full protection of fish and aquatic life and recreation in and on the water be attained by 1983. Each state is responsible for adopting appropriate water quality standards consistent with these goals. Variances from meeting standards for full protection of fish and aquatic life can be granted under certain circumstances.

The variance that the WDNR is proposing for the upper reaches of Badfish Creek and the effluent limits proposed for the Nine Springs Sewage Treatment Plant's discharge to Badfish Creek are intended to provide at least an intermediate level of protection of fish and aquatic life in the upper reaches of Badfish Creek and full protection of fish and aquatic life in the lower reaches of the Creek. All reaches of the Creek would be safe for contact recreation.

The Wisconsin Department of Natural Resources based their proposed variance on the fact that the fishery potential of the Creek is limited because of stream morphology and bottom characteristics. Information presented by MMSD in their facilities plan indicated that a level of effluent and resultant instream water quality suitable for full protection of fish and aquatic life is attainable. (Certain parameters were higher than recommended in Water Quality Criteria, 1972 but lower than background conditions.) It does not appear to this Agency that the documentation provided by the WDNR is sufficient to justify the variance from the goal of fully protecting fish and aquatic life in the upper reaches of Badfish Creek. However, it does appear that full protection of fish and aquatic life may be achieved even with the less strict effluent limits proposed by the WDNR. From a cost standpoint it does not appear to be justified to recommend that MMSD provide the high level of nitrification proposed in their facilities plan without documentation of an incremental water quality improvement, and increased potential for propagation of fish and aquatic life. We recommend, therefore, that the WDNR temporarily suspend promulgating a variance from full fish and aquatic life standards for the upper reaches of Badfish Creek; that the WDNR proposed effluent limits be used as the basis of design for the treatment facilities at Nine Springs STP; and that MMSD conduct bioassays and water quality monitoring in Badfish Creek prior to and subsequent to the operation of the new facilities to determine the impact of the facilities and improved water quality on the aquatic life in Badfish Creek. Based on the results of these studies, a decision can then be made to grant a variance for the upper reaches of the Creek and/or construct additional nitrification facilities.

In addition to the proposed effluent limits for MMSD's discharge to Badfish Creek, the WDNR has also proposed effluent limits for the Oregon

Sewage Treatment Plant discharge to Badfish Creek. The limits proposed for the Oregon STP will require improved treatment by that plant. The limits were determined with consideration of the relatively small loading to the Creek attributable to Oregon compared to MMSD's Nine Springs Plant. The Village of Oregon is presently involved in the facilities planning process.

2. Impact on Groundwater Resources

The proposed actions are not expected to have any significant effect on groundwater resources.

3. Impact on Surface Water Resources

a. Impact on Water Quantity and Hydrology

Section 5.01 E of MMSD's EA adequately summarizes potential impacts related to water quantity and hydrology. One point should be mentioned however. The mitigative measure proposed by MMSD to minimize the expected impacts on low flows in the Yahara River is to augment the low flows during critical periods by managing the levels of the Madison lakes. This mitigation is dependent on the development and implementation of a lake level management program for the Madison lakes to provide the necessary flow augmentation in the upper Yahara River. If no one takes responsibility for initiating the program and it is not instituted, the potential impacts discussed in Section 5.01 E of MMSD's EA and in Volume IV, Appendix C of MMSD's facilities plan can be expected. At this time it can only be assumed that such a program will be instituted since it is outside the scope of this study.

b. Impact on Water Quality

(1) Introduction

As part of MMSD's facilities planning, extensive studies were conducted in order to provide sufficient information on which to base the evaluation of alternatives and to evaluate the impacts of the selected alternative. In addition to the studies referenced or discussed in Chapter 2 of this EIS, the concentrations of many potential contaminants in the present Nine Springs secondary effluent were monitored. Also, the concentrations of many potential contaminants were measured in the receiving streams considered for discharge sites including the proposed discharge to Badfish Creek. The data collected was used in evaluating the treatment processes which should be recommended in order to protect the various potential receiving streams for a number of beneficial uses including protection of fish and aquatic life. In this EIS we will examine the impact of the proposed actions on water quality in Badfish

Creek by evaluating whether the criteria for protection of fish and aquatic life will be met. Our discussion will incorporate the applicable portions of Volume V, Appendix F, Section 5.05 of MMSD's facilities plan. For some parameters such as dissolved oxygen and ammonia nitrogen the information presented in that section no longer appears to be appropriate. We will point out those cases and will provide supplemental discussion. Inserted into the text are photographs of Grass Lake the effluent ditch receiving MMSD's effluent Badfish Creek and the Yahara River below its conference with Badfish Creek. These photographs, Figures 5-1 through 5-27, were taken in the autumns of 1974 and 1977.

(2) General

The criteria for water quality for the protection of fish and aquatic life encompass a wide range of physical and chemical parameters which have been found to have either a direct effect on fish species, or an effect on the numerous aquatic organisms that make up the food chain for the fish community. General categories of such criteria include the following:

- physical criteria such as dissolved gases, suspended matter, etc;
- general chemical criteria such as mineral constituents;
- inorganic toxicants such as ammonia, chlorine and heavy metals;
- organic toxicants such as PCB's, pesticides and detergents.

The following paragraphs contain discussions of constitrants found in the effluent along with the comparison of the concentrations predicted in Badfish Creek as a result of the proposed discharge.

(3) Dissolved Oxygen

The Mackenthun study (1960) discussed in Chapter 2 of this EIS indicated that D.O. levels in Badfish Creek prior to diversion of MMSD's effluent to the Creek ranged from 3.1 - 13.4 p.p.m. in the upper reaches of the Creek (one mile downstream from confluence with effluent ditch) and from 6.6 - 16.7 p.p.m. in the downstream reaches of the Creek (1 1/2 miles upstream from confluence with Yahara River).

Since diversion of MMSD wastewater to the Badfish Creek, dissolved oxygen concentrations during the summer months have been severely

Figure 5-1 Grass Lake

Figure 5-2 Drainage culvert along effluent ditch above in-stream aerator

Figure 5-3 Effluent ditch above aerator

Figure 5-4 Effluent ditch above aerator

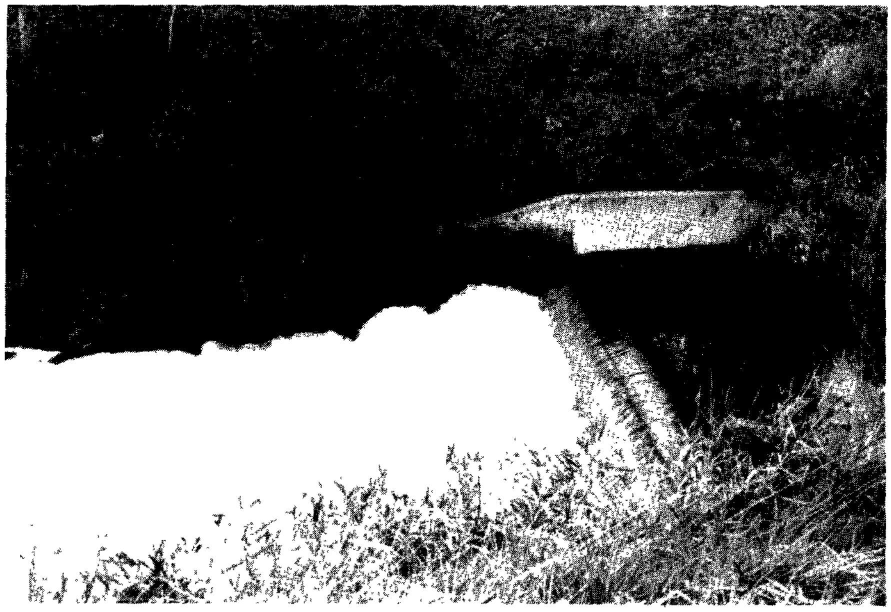


Figure 5-5 Instream step aerator in effluent ditch

Figure 5-6 Downstream of step aerator in effluent ditch

Figure 5-7 Oregon Branch confluence with effluent ditch

Figure 5-8 Badfish Creek, Dane County downstream of Oregon Branch confluence with effluent ditch but above CTH A

Figure 5-9 Downstream of Oregon Branch confluence with effluent ditch but above CTH A

Figure 5-10 Badfish Creek, Dane County, above CTH A

Figure 5-11 Badfish Creek, Dane County, above CTH A

Figure 5-12 Badfish Creek, Dane County, above CTH A

Figure 5-13 Badfish Creek, Dane County, above CTH A

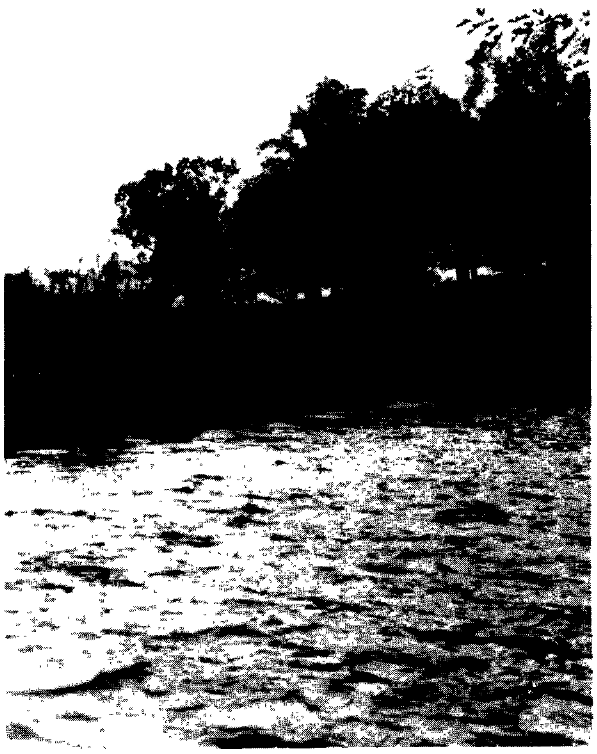


Figure 5-14 Badfish Creek, Dane County, above CTH A

Figure 5-15 Badfish Creek, Dane County, above CTH A

Figure 5-16 Badfish Creek, Dane County, above CTH A

Figure 5-17 Badfish Creek, Dane County, above CTH A

Figure 5-18 Badfish Creek, Dane County, above CTH A

Figure 5-19 Badfish Creek, Dane County, above CTH A

Figure 5-20 Badfish Creek, Dane County, above CTH A

Figure 5-21 Badfish Creek, Rock County, below CTH A

Figure 5-22 Badfish Creek, Rock County, below CTH A

Figure 5-23 Badfish Creek, Rock County, below CTH A

Figure 5-24 Badfish Creek, Rock County, below CTH A

Figure 5-25 Badfish Creek, Rock County, below CTH A

Figure 5-26 Badfish Creek, Rock County, below CTH A

Figure 5-27 Yahara River, Rock County, below confluence with Badfish Creek

depressed, especially in the upper reaches. The Rutland Branch, unaffected by wastewater diversion remains of high quality. The results of the modeling and field data presented in Volume V, Appendix F of MMSD's facilities plan show a severe D.O. sag from the second aerator in the effluent ditch (River Mile = 17.4) to the Rock-Dane County line (RM=7.1) above Cooksville (RM=5.6). This is represented in Figure 5-28.

The water quality modeling projections completed as part of MMSD's planning were based on the assumption that a minimum level of 5 mg/l D.O. would have to be maintained in all reaches of the Creek. The effluent level assumed in the modeling involved a more strict limit on ammonia nitrogen than the level proposed in this EIS. Subsequent to the completion of MMSD's facilities plan, but prior to proposing the revised effluent limitations for Badfish Creek, the WDNR had additional modeling verification and projections completed by the same firm that had completed the modeling for the facilities plan. The results of this additional modeling confirmed that a D.O. level of 5 mg/l will be maintained in all reaches of Badfish Creek with the proposed effluent limits. This would result in a substantial improvement over present D.O. levels in Badfish Creek.

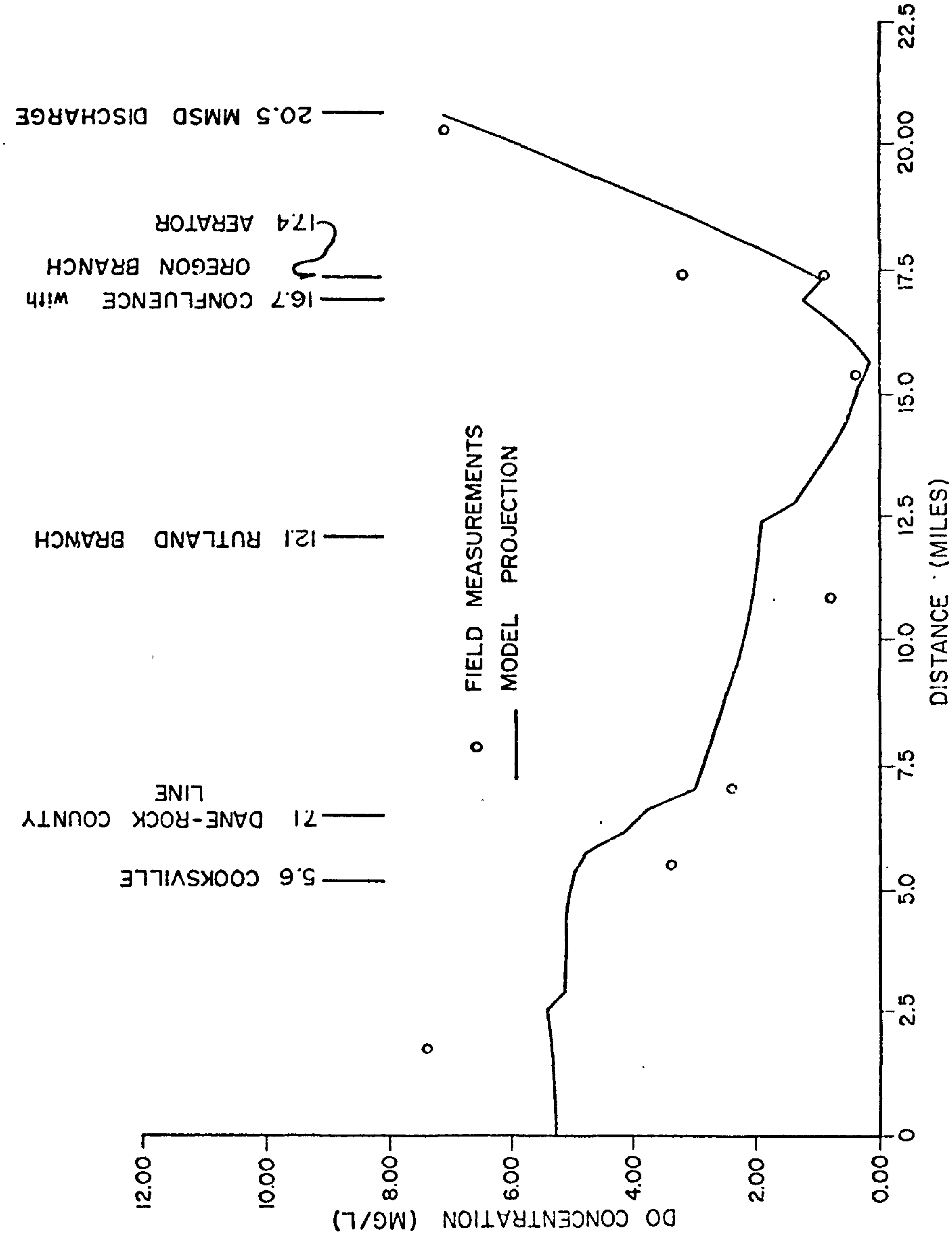
(4) Dissolved CO_2

Extremely high levels of free carbon dioxide (over 60 mg/l) have been found to have a detrimental effect on the oxygen utilization of fish.

Carbon dioxide is one of the end products of the aerobic decay of organic materials and therefore is to be expected in sewage effluents. The amount of free CO_2 existing in solution is a function of pH, alkalinity and temperature. In natural waters with a near neutral pH, free CO_2 concentrations are generally below 20 mg/l. On the other hand, CO_2 is utilized by algae as a source of carbon in their metabolism. Thus during the summer low flow periods, when dilution water for the waste discharge is minimal, natural CO_2 levels are being reduced by algal uptake. It is highly unlikely the free CO_2 concentrations in Badfish Creek would ever rise to anywhere near the 60 mg/l level reported in Water Quality Criteria as having a detrimental effect on fish. The recommended re-aeration of the effluent at the discharge point would tend to strip free CO_2 from solution thus providing further protection for the fish and aquatic life in the receiving streams.

(5) Suspended and Settleable Solids

High concentrations of suspended and settleable solids are thought to have detrimental effects on the aquatic community. Suspended solids may irritate the gills of fish while settleable solids may blanket the bottom organisms and interfere with fish spawning.



MMSD FACILITIES PLAN

BADFISH CREEK MODEL VERIFICATION

SURVEY - OCT. 9, 10, 1975

FIGURE 5-28

O'BRIEN & GERE ENGINEERS, INC

The 1972 edition of Water Quality Criteria lists the following maximum values as providing varying levels of protection for the aquatic community.

- High level of protection - 25 mg/l or less
- Moderate level of protection - 25-80 mg/l
- Low level of protection - 80-400 mg/l
- Very low level of protection - 400 mg/l or more

Settleable and suspended solids in a water body are technically differentiated only by their relative abilities to settle or remain in solution in a laboratory vessel. Solids that may settle in the quiescence of the breaker may nevertheless remain suspended due to the velocity of the receiving stream.

The natural runoff from agricultural and/or urban areas may contribute the major portion of settleable and suspended solids to the stream. Because of the use of settling tanks in sewage treatment processes, large quantities of settleable solids are not characteristic of a treated sewage effluent. However, some of the suspended particulate matter that does escape in the treated effluent may agglomerate with other materials in the receiving stream and result in the formation of heavier particles that do tend to settle in the quiet backwater areas of the stream. Thus control of suspended and settleable solids levels in a receiving stream entails both runoff control and control of the suspended solids present in any treatment plant effluent discharge. Also, an additional source of solids that may settle in the quiet backwaters that cannot be controlled may originate from bacterial growths, slime formation and algal synthesis in the stream.

As part of the proposed effluent limits for the Nine Springs Treatment Plant, the WDNR has specified that suspended solids concentrations in the effluent will be based on design criteria and that a daily maximum of 20 mg/l appears reasonable based on the BOD characteristics of the effluent.

Table 5-1 shows the effect of Nine Springs effluent on the suspended solids levels in the receiving streams.

Suspended solids data collected at Station 1 at the headwaters of Badfish Creek both prior to and after diversion of the effluent shows a slight decrease in the annual average suspended solids concentration and a marked decrease in the average annual range of suspended solids fluctuations in the Creek after diversion of effluent. Similar data shown for the summer months at the same station reveal a marked decline in the average suspended solids concentration. Again there is a sizeable decrease in the range of fluctuations of suspended solid levels.

TABLE 5-1

EFFECTS OF NINE SPRINGS EFFLUENT ON
SUSPENDED SOLIDS CONCENTRATIONS OF
RECEIVING STREAMS

	Pre-Diversion (1955-1958)				Post Diversion (1972-1975)			
	Annual Avg.	Range	Summer Avg.	Range	Annual Avg.	Range	Summer Avg.	Range
Badfish Creek - Headwaters (Sta. #1)	28.69	259	24.78	169	27.77	118	13.18	22
Badfish Creek - Mouth (Sta. #8)	55.85	972	25.24	154	58.08	176	44.11	89
Yahara River - Downstream Badfish (Sta. #9	35.03	254	40.24	137	64.02	314	74.71	245
Yahara River - Upstream Badfish (Sta. #10)	31.91	329	52.35	316	55.44	315	91.00	297
Rock River - Downstream Yahara (Sta. #16)	38.25	90	44.82	55	45.79	100	46.68	59
Rock River - Upstream Yahara (Sta. #15	41.35	90	46.62	78	49.55	135	62.32	113
Wisconsin River - Prarie du Sac					9.84	49	11.32	48
Rutland Branch - Badfish Creek	45.23	392	19.97	91	19.68	65	13.79	50

Note: All values in mg/l

Similar data for Station 8 at the mouth of Badfish Creek shows a slight decline in average suspended solids concentrations and a sharp decline in the range of values during the entire year. However the data shows a marked increase in the average summer concentrations after diversion. The range of summer fluctuations is again lower than the range which existed prior to diversion.

While the average annual concentration of suspended solids in Badfish Creek did not change appreciably after diversion, the quality of suspended solids transported down the stream did change.

At Station 9 on the Yahara River average annual suspended solids values prior to diversion were recorded at 35 mg/l. After diversion, the concentrations of suspended solids rose to 64 mg/l. At this station, the range of values was greater after diversion. Summer data for Station 9 shows an increase in the average suspended solids concentration from 40 mg/l to 74 mg/l. The range of values during the summer rose from 137 mg/l to 245 mg/l.

It should be pointed out, however that the annual average suspended solids values also rose considerably at Station #10 in the Yahara River, which is above the confluence of the Badfish Creek and not subject to the influence of the MMSD effluent. In addition the average summer suspended solids values at Station #10 (upstream of Badfish) increased markedly over the values at Station #9 (downstream of Badfish).

The suspended solids data from Station #16 on the Rock River below the confluence of the Yahara River, and still above Janesville, indicates that the average suspended solids concentration was again slightly higher after diversion of the effluent into Badfish Creek. In this case the average concentration rose from 38.25 mg/l to 45.79 mg/l. It should again be noted that the suspended solids concentrations at Indianford Dam (Station #15) upstream from the Yahara River, and thus upstream of any influence of the MMSD effluent, show the same general trend of increased suspended solids concentrations, but the actual values are higher upstream than downstream. These same general increases were found to apply to the summertime concentration.

While it is conceded that the discharge of sewage effluent to Badfish Creek resulted in a somewhat increased solids loading on the Badfish Creek and Yahara River, the resulting average concentrations in all of the streams (Badfish, Yahara and Rock) both during the summer and on a year-around average basis, would appear to be within the range of values specified in Water Quality Criteria as providing a high to moderate level of protection for the aquatic communities.

In summary, it would appear that no additional of treatment is warranted from the standpoint of suspended solids removal alone. The filtration provided for removal of suspended solids for recreational use of water in Badfish Creek would result in lowering an already acceptable suspended solids concentration from an aquatic life standpoint.

(6) Temperature

The temperature of a receiving stream plays an important role in the determination of the type of aquatic life inhabiting its waters.

The discharge of treated sewage effluent into a small body of water would result in an increase in the natural stream temperature. A change in temperature could alter the aquatic community of the stream as indicated in Appendix E, Volume IV, of MMSD's facilities plan.

Table 5-2 is a tabulation of the average annual and average summer temperatures in the receiving streams of the area, both prior to and after diversion of the effluent into Badfish Creek.

The data show that the discharge of treated effluent into the Badfish Creek raised the average yearly temperature of the creek approximately 6°C at Station #1 at the headwaters and approximately 2°C at Station #8 near the mouth of the creek. The average summer temperature was raised roughly 4.2°C at the headwaters and 1°C at the mouth.

While slight increases in average yearly and average summer stream temperatures are noted for the other sampling locations downstream on the Yahara and Rock Rivers, these same slight increases are noted at Stations #10 and #15 which are not affected by the MMSD discharge and at locations on the Rutland Branch and the Wisconsin River. Therefore, it is likely that the increases in the streams other than the Badfish are a result of natural air temperature differences between the two periods (1955-1958 and 1972-1974).

The maximum summer temperature for all of the streams in the area would appear to be in a high range with the Rutland Branch and Badfish Creek which are fed by groundwater, having the lower temperatures (18-25°C) and the Rock and Yahara Rivers which are fed by lakes having the higher temperature values (27-31°C).

The minimum winter temperature is changed only at Station #1 in the headwaters of Badfish Creek, although the duration of freezing water temperatures after diversion is considerably shortened.

It is anticipated that any additional steps of treatment which increase the detention time of the sewage will tend to bring the sewage temperature closer to the ambient air temperature during all seasons. Thus in

TABLE 5-2

EFFECTS OF NINE SPRINGS EFFLUENT ON RECEIVING STREAM'S TEMPERATURE

	Average Yearly Temperature		Average Summer Temperature		Peak Summer Temperature		Minimum Winter Temperature	
	Before Diversion	After Diversion	Before Diversion	After Diversion	Before Diversion	After Diversion	Before Diversion	After Diversion
Badfish Creek Sta. #1 Head-waters	8.96°C	14.92°C	15.79°C	19.97°C	24°C	25°C	0°C	5°C
Badfish Creek Mouth Sta. #8	10.33°C	12.44°C	18.00°C	19.07°C	27°C	28°C	0°C	0°C
Yahara River Downstream Sta. #9	11.60°C	12.47°C	20.20°C	20.03°C	30°C	27°C	0°C	0°C
Yahara River Upstream Sta. #10	12.00°C	12.55°C	20.89°C	20.86°C	31°C	28°C	0°C	0°C
Rock River Sta. #16 Downstream	12.8°C	13.49°C	20.74°C	21.93°C	30°C	28°C	0°C	0°C
Rock River Sta. #15 Upstream	12.35°C	12.67°C	20.16°C	21.17°C	28°C	28°C	0°C	0°C
Wisconsin River Praire du Sac	---	8.66°C	---	22.64°C	Unknown	Unknown	Unknown	Unknown
Ruthland Br. - Badfish Creek Sta. #3	8.87°C	9.55°C	13.26°C	13.52°C	20°C	18°C	2°C	0°C

the summer, the sewage effluent would tend to be warmer, and in the winter the effluent would tend to be colder. It is anticipated that this effect would result in a net change of not more than 1 or 2 degrees. Hence, it would not materially change the temperature of the stream receiving the discharge.

Table 5-3 lists the optimum water temperatures for spawning and growth of fish species found in Wisconsin.

(7) Color and Turbidity

The combined effects of color and turbidity in a receiving stream may reduce light penetration to the point that reduced photosynthesis results in decreased oxygen production and reduced dissolved oxygen levels in the stream.

The 1972 edition Water Quality Criteria specified that the combined effect of color and turbidity should not change the compensation point more than 10% from its seasonally established norm.

The color of the Nine Springs secondary effluent was found in the effluent characterization to range from 30 to 40 platinum-cobalt units. Accompanying turbidities ranged from 10 to 40 Jackson Turbidity Units. No background data is available on the color levels in the receiving streams. Visual observations showed Badfish Creek to have a rather low background color level.

It is anticipated that the nitrification and filtration treatment steps, recommended in order to maintain dissolved oxygen levels, would result in much lower turbidities in the effluent such that the light penetration on the effluent would be about equal to the light penetration of the natural waters in the Badfish Creek.

(8) Acidity, Alkalinity and pH

The natural pH of a receiving stream is a function of its acidity and alkalinity constituents. The acidity is the result of CO_2, mineral acids, weak acids and hydrolyzing salts. The alkalinity is a result of carbonate, bicarbonate and hydroxide components of the water.

Waters of high alkalinity have an excellent buffering capacity and resist sudden and drastic pH changes.

The recommendations with regard to alkalinity and pH contained in Water Quality Criteria are as follows:

TABLE 5-3

OPTIMUM TEMPERATURES FOR SPAWNING & GROWTH FOR VARIOUS SPECIES OF FISH

SPECIES	REQUIRED TEMPERATURE FOR SPAWNING		PREFERRED TEMPERATURE FOR GROWTH
	Water Quality Criteria 1972[1]	Freshwater Fishes of Canada[2]	Freshwater Fishes of Canada[2]
Sauger	5.0	3.9-6.1	18.6-19.2
Brown Trout	-	6.7-8.9	18.3-23.9
Rainbow Trout	-	10.0-15.5	21.0
Walleye Pike	7.0	6.7-8.9	13.0-18.0
Northern Pike	-	4.4-11.1	-
Yellow Perch	-	8.9-12.2	19.0-21.0
Mottled Sculpin	-	10.0	16.6
White Sucker	12.0-13.0	-	-
Big Mouth Buffalo	15.6-18.3	15.6-18.3	-
Common Shiner	15.6-18.3	15.6-18.3	-
Johnny Darter	18.0	-	-
Large Mouth Bass	15.6	16.7-18.3	26.6-27.7
Small Mouth Bass	18.7	16.1-18.3	21.3
Carp	19.0	17.0-26.0	-
Bluegill	19.4	-	-
Black Crappie	20.0	19.0-20.0	-
Brown Bullhead	21.1	21.1	-

NOTE: All values given in centigrade degrees.

1. National Academy of Sciences, National Academy of Engineering, "Water Quality Criteria 1972", USEPA, 1972.
2. Scott, B.V. & Crossman, E.J. "Freshwater Fishes of Canada", Bulletin 184, Fisheries Research Board of Canada, 1973.

Source: Volume V of MMSD's facilities plan

For a nearly maximum level of protection of aquatic life, the pH should be maintained between 6.5 and 8.5 and no change greater than 0.5 units above or below the natural seasonal maximum and minimum values should be introduced.

The allowable ranges for high, moderate and low levels of protection are specified as follows:

High Level	pH 6-9	change less than ±0.5 units
Moderate Level	pH 6-9	change less than ±1.0 units
Low Level	pH 5.5-9.5	change less than ±1.5 units

In addition, it is recommended that the total alkalinity of the waters not be decreased more than 25% below the natural levels.

With respect to Badfish Creek, it should be noted that both the average yearly pH and the average summer pH for the Creek are roughly the same indicating very little photosynthetic activity present either before or after diversion of the effluent into the creek. In general, it can be said that the treated effluent acted to lower the pH of the stream roughly 0.5 units along its entire length. Thus diversion had no detrimental effects on the pH regime of the stream and nearly maximum levels of protection were provided before and after diversion.

The effect of the Badfish Creek flow on the Yahara River after diversion can be viewed as beneficial in that it resulted in reduction of pH downstream of the confluence. The extremely high summer pH values in the Yahara prior to diversion (9.06-9.20) were reduced to more acceptable values (8.09-8.59) following diversion of the effluent.

The lower pH values in the Yahara River after diversion show a resulting reduction in the pH of the Rock River. However, it should be noted that there was also a slight decline in pH present in those streams and portions of streams not subjected to the MMSD effluent. Therefore, it is likely that a portion of the pH reduction noticed in all cases, is attributable to the difference between the rainfall patterns and stream flows in the periods compared.

The information presented in Volume V, Appendix F of MMSD's facilities plan indicated that the addition of nitrification, chlorination and dechlorination treatment steps would result in a slight lowering of the effluent pH in the future. The proposed facilities will provide for an adequate level of protection for the receiving stream from an pH standpoint since the effluent must allow for a pH of between pH 6-9 in Badfish Creek in order to meet pH criteria for the stream.

(9) Dissolved Solids and Hardness

Total dissolved solids (TDS) are a quantitative measure of the concentration of dissolved minerals in the water. The background dissolved solids characteristics of the Badfish Creek, and the Yahara and Rock Rivers and the Wisconsin River are, in all probability, determined by the TDS concentration of the groundwaters in the area which seep into the stream directly and are also discharged to the stream after human use.

The total dissolved solids content of the MMSD sewage effluent, however, is expected to be noticeably higher than both the groundwater and the receiving streams since the sewage is heavily influenced by the large quantities of salt brine (NaCl) which result from the regeneration of zeolite home water softeners. The discharge from the Oscar Mayer plant also contains high levels of salt (NaCl) which contribute to the higher TDS content of the effluent as shown in Section 4.02 of Volume I of MMSD's facilities plan.

Recommendations in Water Quality Criteria are extremely general and state that "total dissolved materials should not be changed to the extent that biological communities characteristic of the particular habitat are changed."

The range of TDS change that will cause damage to the aquatic community is not well defined. It has been reported in the 1972 edition of Water Quality Criteria that the upper limit of allowable concentrations to protect freshwater fish from osmotic stress is between 5000 and 10,000 mg/l. Thus a considerable margin of safety would seem present in Badfish Creek since concentrations in the Creek range from approximately 525-1127 mg/l and concentrations in the effluent from Nine Springs Sewage Treatment Plant ranged from 739-1079 mg/l.

The 1968 edition of Water Quality Criteria recommends that TDS concentrations in the receiving stream not be increased by more than one-third of the natural concentration.

McKee and Wolf, however, in the 1968 Edition of California Water Quality Criteria report that the natural osmotic pressure of the blood of most freshwater fishes is roughly equivalent to six atmospheres, or 7000 mg/l, of sodium chloride. This same reference reports that freshwater fish have been found to live well in sea water diluted to this level.

It is apparent that there is little or no agreement on the specific limiting concentrations of TDS that are required in order to protect fish and aquatic life. There would seem to be a consensus of opinion, however, that rapid changes in TDS concentrations would definitely have harmful effects from an osmotic pressure standpoint.

The biological survey conducted by the University of Wisconsin as a part of this facilities plan found no drastic differences in the fish communities in the Yahara River above and below the discharge of Badfish Creek. It can, therefore, be assumed that the increased salinity in the Yahara River below its confluence with the creek did not appreciably affect the aquatic community.

There are no economically available methods for reducing the TDS concentration of water. Therefore, no additional levels of treatment can be recommended for this purpose and the TDS levels in the effluent can be expected to remain essentially the same as at present.

(10) Oils and Tainting Substances

Oils in a receiving stream may be in the form of floating oils or emulsified oils which eventually settle and become part of the sediments. Oils as such are not a common concern in secondary sewage effluents since most oils are adequately broken down by the micro-organisms in a biological treatment system. Vegetable oils and common greases are, however, present in sewage and small quantities are contained in a sewage effluent. In general, the oils escape as either floating scum or as oil and grease attached to solid particles of biological floc.

Typical oil and grease concentrations found in the Nine Springs effluent characterization program range from 0-35 p.p.m. with the higher values associated with higher sewage flows and lessened removal efficiencies.

Floating oil and grease can be adequately removed by effective skimming of the effluent as suggested for protection of the aesthetic use of the receiving waters.

Since emulsified oils and greases are commonly attached to solid particles, they should be effectively removed by the filtration of the effluent which is required from a recreational use and dissolved oxygen standpoint.

One of the most frequent chemical groups associated with tainting of fish flesh by sewage effluent are phenolic compounds.

It has been reported that phenol concentrations of 0.1 mg/l in sewage have had a detrimental effect on the palatability of freshwater fish.

Total phenol concentrations in the Nine Springs effluent were found to range from 0.005 mg/l to 0.210 mg/l during the effluent characterization survey. The average value for the highest 24-hour composite was 0.089 mg/l. Thus, the average effluent concentration could be expected to be less than the 0.1 mg/l found to cause fish flesh tainting.

Data on phenol levels in the receiving waters are very limited.

It is not anticipated that the concentration of phenolic materials in the receiving waters are causing a fish flesh tainting problem at the present time, nor that such a problem will exist in the future.

No additional levels of treatment are recommended to protect the fish life in the receiving stream from tainting caused by phenolic compounds.

(11) Ammonia Nitrogen

According to the Mackenthun study discussed in Chapter 2 of this EIS, the Oregon Sewage Treatment Plant affected inorganic nitrogen levels in Badfish Creek prior to diversion. The study also shows that inorganic nitrogen concentrations and volumes (particularly of ammonia nitrogen) increased significantly after diversion with concentrations decreasing moving downstream.

As discussed in Chapter 2 of this EIS, present ammonia nitrogen levels in Badfish Creek currently exceed recommended limits for protection of fish and aquatic life from toxicity.

The effluent limits proposed by the WDNR are expected to provide for full protection of fish and aquatic life in all reaches of Badfish Creek. The 0.02 mg/l maximum un-ionized ammonia limit would not be violated.

(12) Heavy Metals

Numerous heavy metals found in the Madison Sewage effluent are known to have detrimental effects on fish and aquatic life in a receiving stream if present in toxic concentrations.

Table 5-4 is a comparison of the heavy metal concentrations found in the Nine Springs effluent with allowable concentrations in the receiving stream found to be necessary for the protection of fish and aquatic life.

It should be noted that in most cases the allowable concentrations specified for the protection of fish and aquatic life are much lower and more stringent than those allowable for the protection of drinking water for livestock and humans.

The referenced allowable standards have been taken, where available, from the recommendations contained in the "Freshwater Aquatic Life Section" of the 1972 edition of Water Quality Criteria. Where no recommendations were available, in that report, the listed values were taken from the recommendations contained in the 1968 edition of Water Quality Criteria by McKee and Wolf. In those cases where recommendations were not found in either report, the listed value represents the lowest concentration found to be necessary, in either of the reports, for protection of any member of the aquatic community felt to be a potential inhabitant of the

TABLE 5-4
COMPARISON OF HEAVY METAL CONCENTRATIONS
NINE SPRING EFFLUENT AND ALLOWABLE VALUES FOR PROTECTION OF FISH AND AQUATIC LIFE

Metal	Average Value	Highest 4-hour Composite	Maximum Recommended Allowable Concentration	References	Determination
Aluminum	0.344 mg/l	0.670 gg/l	0.10 mg/l	a	Further study
Antimony	0.039 mg/l	0.200 mg/l	0.80 mg/l	b 7 1	No concern
Arsenic	0.037 mg/l	0.080 mg/l	0.11 mg/l	b	No concern
Barium	0.635 mg/l	1.20 mg/l	5.0 mg/l	b	No concern
Beryllium	<0.001 mg/l	<0.001 mg/l	0.15 mg/l	b & 2	No concern
Boron	<0.01 mg/l	<0.01 mg/l	200. mg/l	b & 3	No concern
Cadmium	<0.001 mg/l	<0.001 mg/l	0.03 mg/l	a	No concern
Chromium (total)	0.016 mg/l	0.050 mg/l	0.05 mg/l	a	No concern
Copper	0.015 mg/l	0.040 mg/l	0.01 mg/l	a & 4	Further study
Iron	0.181 mg/l	0.612	0.7 mg/l	b & 5	No concern
Lead	0.044 mg/l	0.182	0.03 mg/l	a	Further study
Manganese	0.121 mg/l	0.400 mg/l	1.0 mg/l	b	No concern
Mercury	2.22 ug/l	5.68 ug/l	2.0 ug/l	a & 6	Further study
Molybdenum	<0.001 mg/l	<0.001 mg/l	54 mg/l	b & 7	No concern
Nickel	0.024 mg/l	0.055 mg/l	0.1 mg/l	a & 8	No concern
Selenium	0.047 mg/l	0.140 mg/l	0.25 mg/l	b & 9	No concern
Silver	0.003 mg/l	0.010 mg/l	0.003 mg/l	b & 10	Further study
Tin	<0.001 mg/l	<0.010 mg/l	1.2 mg/l	b & 11	No concern
Vanadium	<0.01 mg/l	<0.01 mg/l	3.0 mg/l	b & 12	No concern
Zinc	0.096 mg/l	0.168 mg/l	0.10 mg/l	a & 13	Further study

TABLE 5-4 CONTINUED

References:

a) Water Quality Criteria 1972 National Academy of Science, National Academy of Engineering 1972

b) Water Quality Criteria 1963 J. E. McKee and H. W. Wolf

1) Sb based on .01 x TLm antimony Trioxide in hard water

2) Be based on .01 x TLm Beryllium chloride in hard water

3) B based on study by Wortz on Rainbow trout

4) Cu based on work by Biesinger et.al. for protection of Daphnia Magna

5) Fe based on 95% of waters in U.S. with good fish populations having concentrations less than 0.7 mg/l

6) Hg based on standard for methylmercury p.174

7) Mo based on protection of scenedesmus

8) Ni based on work of Biesinger et.al. for protection of Daphnia Magna

9) Se based on 0.1 median threshold effect on Scenedesmus & Daphnia Magna

10) Ag based on lethal concentration limit for stickle backs by Jones

11) Sn based on data on protection of young eels

12) V based on 0.1 x 96 TLm hardwater fathead minnows using vanadyl sulfate

13) Zn based on median safe concentration for fathead minnow reproduction

Source: Volume V, Appendix F, Section 5.05 of MMSD's Facilities Plan receiving waters under consideration. Likewise, values used reflected hard water conditions in each case since the receiving streams in the area are hard water streams.

The source of the reference is listed in each case and in those cases where no recommendation is available in either report, further references are given as to the basis of the value listed in the table.

The last column in the table shows the determination made as a result of the comparison. It should be noted that where the highest concentration found in any of the 4-hour composites is lower than the allowable value in the stream, there is no concern that the effluent will adversely affect the receiving stream; thus these parameters determined to be in need of further study are those where either the average concentration or the maximum concentration exceed the allowable values.

Table 5-5 is a comparison of heavy metals in the effluent which are found to require further study with the concentrations of those same metals found in the receiving streams of the area which are not affected by the effluent discharge.

It should be noted that concentrations of many of the elements are higher in some of the natural streams than they are in the effluent.

For instance, the Rutland Branch of Badfish Creek was described by Magnuson and Herbst (1975) as a pristine stream. Yet the data collected shows the concentrations of certain metals including aluminum, copper, mercury and zinc to exceed, at times, the average values found in the Nine Springs effluent. Likewise, the waters of Spring Creek, another rather natural tributary, contain concentrations of copper, mercury and zinc which are both in excess of the average concentrations found in the sewage effluent.

It is apparent that the average concentrations present in the MMSD effluent are not decidedly toxic.

The allowable values assigned for each parameter in Tables 5-4 and 5-5 are those values, which if present in the stream, on a consistent basis, would protect the aquatic life from chronic long-term toxicity. The values are usually arrived at by taking a reported concentration (TLm or LC50) at which 50% of the test individuals were killed in some time (24-96 hrs.) and then multiplying that value by applying a factor of from 1/50 to 1/100 of that value to protect against chronic or longterm toxicity.

Fish and other forms of aquatic life are able to withstand higher concentrations than those allowed for shorter periods of time without severe detrimental effects, provided that the absolute change in concentration is not too abrupt, and the individual species have time to acclimate to a gradually increasing concentration.

Table 5-5
Comparison Of Selected Heavy Metal Concentrations
Nine Springs Effluent and Natural Streams

Parameter	Average 9-Springs Effluent	Rutland Branch Stat. 1-1	Spring Creek	Yahara River Upstream Stat. 4-10	Rock River Upstream	Wisconsin River	Maximum Recommended Allowable Conc.
Aluminum	0.344	0.2-0.5	--	0.4-1.9	0.14-1.13	<0.5	0.10
Copper	0.115	0.03-0.20	< 0.01-0.10	0.02-.23	< 0.002-.036	<0.01	0.01
Lead	0.044	< 0.01	< 0.01	< 0.10	< 0.02-.10	--	0.03
Mercury	2.22	3.34-7.26	3.04-7.06	1.54	<0.1	<0.1-3.6	2
Zinc	0.096	0-.129	0-.123	.01-.07	0.002-0.7	< 0.001	0.10

Note: All values except mercury in mg/1. Mercury in ug/1

Source; Volume V, Appendix F, Section 5 of MMSD's Facilities Plan

In order to alleviate potentially rapid changes in the concentrations of heavy metals, equalization of the effluent will be provided.

Table 5-6 is a tabulation of concentrations of those specific parameters found to be potentially harmful to the fish and aquatic life in the receiving stream. The table lists the average concentration of each parameter found during the effluent characterization survey as well as the highest 4-hour, 8-hour, 12-hour, and 24-hour composite values found.

As shown in Table 5-6, the provision of equalization would result in a sizeable reduction in the fluctuations of heavy metal concentrations that would be imposed on the receiving stream. In general, the larger the period of equalization, the better the protection offered.

Table 5-6
Equalized Effluent Concentrations

PARAMETER	Maximum Recommended Allowable Concentration	Highest 24-hr. Concentration	Highest 12-hour Concentration	Highest 8-hour Concentration	Highest 4-hour Concentration
Aluminum	0.10	0.53	0.57	0.60	0.70
Copper	0.01	0.027	0.033	0.035	0.040
Lead	0.03	0.133	0.15	0.155	0.180
Mercury	2	2.95	3.35	4.04	5.68
Silver	0.003	0.01	0.01	0.01	0.010
Zinc	0.10	0.107	0.127	0.138	0.168

Note: All values in mg/l except mercury. Mercury in ug/l.
Source: Volume V, Appendix F, Section 5.05 of MMSD's Facilities Plan

Since, in general, the high values are pronounced peaks which rise and fall substantially within a given 8-hour manufacturing period, the choice of equalization time should be chosen as 8 hours or more. Since the passage of the peaks through the treatment plant tends to depress and spread out any peak, it is felt that a twelve hour equalization period would be the optimum choice for depressing peak metal values. Any equalization period greatly exceeding 8-12 hours would possibly create a detrimental effect in that algal growth could occur in the equalization facility since planktonic algae have a relatively rapid generation time on the order of 12 hours at 25 C. Any algal growth would create an additional oxygen demand on the receiving stream.

A pond or structure providing a total of twelve hours of equalization is recommended to prevent shock loading of heavy metals from entering the receiving stream.

Table 5-7 is a tabulation of selected heavy metal concentrations measured at various points along the effluent discharge route during the biological studies which were conducted from April to October of 1975. From this data the following observations can be made.

Aluminum

Aluminum in the treatment plant effluent exceeds the recommended limit. However, major quantities of aluminum are apparently contributed by the Rutland Branch and Spring Creek. These natural sources appear to have a much more pronounced effect on Badfish Creek than does the concentration in the effluent. Considerable aluminum is also contributed by the upper reach of the Yahara River where the concentration is again considerably higher than the concentration in the sewage effluent.

In view of the rather good fish populations in the tributary streams containing high concentration of aluminum, it is apparent that this metal constituent is not seriously limiting the aquatic community. Therefore, no additional levels of treatment are recommended specifically for the reduction of effluent aluminum concentrations.

It is, however, recommended that efforts be made to find the major sources of aluminum in the MMSD system and control this parameter at its source.

Copper

The levels of copper while in excess of recommended levels are, nevertheless, in the same range as the levels found in tributaries of Badfish Creek and the Yahara River which are unaffected by the effluent discharge. No additional levels of treatment can be justified for the removal of this parameter.

Lead

The background concentrations of lead in many of the effluent samples were below the 0.01 mg/l concentration recommended as allowable. However samples on one day contained lead concentrations of 0.1 mg/l. It is felt that these higher concentrations are the result of an industrial discharge at some point in the MMSD system. It is recommended that efforts be directed at locating the source of the lead discharge and the elimination of the materials at the source.

Mercury

The slightly higher than allowable concentration of mercury in the effluent may be a result of industrial mercury use, and any source of mercury discharge into the MMSD system should be identified and the problem corrected at the source.

The fact that the same range of mercury concentrations was found in the waters of the Rutland Branch and in Spring Creek gives cause to suspect that the source of mercury in the area may be involved insome way with agricultural operations. Mercury is included in some pesticide formulations and it is possible that crops in the area may be treated with a mercury based pesticide.

A WDNR survey was conducted in 1972 (Konrad and Kleinert, 1974) of the metal concentrations in numerous sewage plants in Wisconsin. Their mercury readings of the plant influents showed Madison to have the third highest concentration of the thirty-five plant influents monitored. The Madison concentration of 0.013 mg/l was exceeded only by Kaukauna at 0.08 mg/l and Racine at 0.24 mg/l. The reported effluent value, however, was less than 0.0005 mg/l.

Relatively high concentrations of mercury were found in the sediments of the MMSD outfall ditch by the DNR (Konrad, 1971) and it was theorized, in that study, that the high alkalinities of the receiving waters limit the availability of the mercury in the sediments thus avoiding detrimental effects on fish.

It is recommended that MMSD perform intensive sampling to locate the source of this element and develop a source control program.

Zinc

The levels of zinc found in the MMSD effluent are of the same order of magnitude as the higher end of values found in tributary streams. It would seem that this level of zinc has not proven to be detrimental in the receiving waters of the area.

While no additional treatment levels are recommended for the removal of zinc, it is recommended that MMSD locate zinc sources in their system and again seek to control this parameter at its source.

In summary, it would appear from an analysis of heavy metal data that average heavy metal concentrations in the secondary effluent would not be detrimental to fish and aquatic life in Badfish Creek.

Peak concentrations of certain elements, including aluminum, copper, lead, mercury, silver and zinc could cause temporary detrimental effects to certain sensitive species.

Effluent filtration which was recommended to reduce the suspended solids load on the stream will undoubtedly achieve further removals of the metals of prime concern.

In order to further alleviate the possibility of these temporary detrimental effects it is recommended that twelve hours of effluent equalization be provided.

It is also recommended that MMSD institute a vigorous industrial waste program whereby the MMSD would locate industrial sources of key heavy metals in their system and take appropriate steps to remove portions of these metal contaminants at their source.

Cyanides

Cyanides are utilized in certain metal plating operations. Cyanides which have been known to be toxic to man, fish and aquatic life. Both free and complex cyanides are usually present in wastewaters from industrial plating operations.

Free cyanide (HCN) can be satisfactorily destroyed by the micro-organisms in a biological treatment system when the system is acclimated to the material, and the concentrations do not change radically from hour to hour or day to day.

Complex cyanides, on the other hand, are usually bound up with metallic complexes containing copper, zinc or other heavy metals, which inhibit the biological breakdown of the complex. By the same token, complex cyanides are usually contained in fine precipitate with the metal and might be removed by filtration.

Total cyanide values found in the MMSD effluent ranged from less than 0.01 mg/l with the average value of all samples being 0.157 mg/l. Many of the samples were virtually free of cyanide and on those occasions when it was present, the concentration rose abruptly and fell off rapidly reflecting the possibility of an industrial release of the material. Since the material passed through the secondary treatment unit, it is assumed that much of the material is in the complex form. It is anticipated that additional removals will be accomplished by filtration.

It is recommended in the 1972 edition of Water Quality Criteria that free cyanide levels in the receiving stream be kept below 0.005 mg/l. The addition of a biological nitrification step should insure that free cyanides will be effectively broken down in the treatment process and filtration will remove much of the complexed cyanide material which could possibly revert to free cyanide. In addition, it is recommended that MMSD locate sources of cyanide in their system and insure that any free or complex cyanides are either destroyed before discharge or are discharged at a rather uniform rate such that the treatment system can adequately destroy them.

(13) Detergents

The prime toxicant in detergents is the sulfonated compound used as the base building block for the detergent compound. Until 1965, the use of relatively non-biodegradable alkylbenzene sulfonates (ABS) resulted in severe foaming in sewage treatment plants and in receiving streams. In 1965 the industry switched to a more biodegradable base compound called linear alkylate sulfonate (LAS) in response to increasing environmental concerns. Most of the detergent residue in sewage today is residual LAS.

The standard test for detergent residues is the test for Methylene Blue Active Substances (MBAS) which include both ABS and LAS in the total of the surfactants measured.

MBAS test results, run on the Nine Springs effluent, showed concentrations ranging from less than 0.1 to 0.4 mg/l, with the average value being 0.2 mg/l. The 1972 edition of Water Quality Criteria recommends that the average LAS concentration in the receiving stream not exceed 0.2 mg/l.

If it is assumed that all of the MBAS found in the effluent is LAS, then the average value in the effluent is equal to the allowable value in the receiving stream, and no detrimental effects are to be expected. The higher temporary values of 0.4 mg/l should likewise not be detrimental to aquatic life. Additional treatment steps recommended for other purposes such as nitrification and filtration should result in longer contact times in the biological-system and further reductions of LAS concentrations in the effluent.

(14) Pesticides

Many of the pesticide compounds which man has invented for destruction of harmful insects and to protect lawns, gardens, farm crops and other vegetation from damage or destruction due to pests have been shown to have detrimental effects on other non-target terrestrial and aquatic inhabitants of the ecosystem. Many of the pesticides have been shown to be relatively resistant to chemical decay and persist in the environment for long periods of time. Chlorinated hydrocarbon pesticides and mercury pesticides are examples of compounds which are known to be concentrated in the aquatic food chain such that a cumulative effect develops in the entire food chain. At some point in time the cumulative concentration reaches the point where lethal or toxic effects are evident at some level of the food chain, either in fish, wildlife or in man. In many cases the allowable concentrations of these compounds in water are established at a level which has been found necessary to protect man against the excessive concentrations found in fish.

Mercury included in mercury pesticides has been discussed as a part of the heavy metals problem; however, the general problem of mercury is one that is also closely tied with any discussion of pesticides.

Three different pesticide screening tests were performed as a part of the effluent characterization study in order to assess the general level of pesticide contamination in the effluent.

The test for chlorinated hydrocarbon pesticides revealed concentrations ranging from less than 0.1 ug/l to 3.2 ug/l with the average value of 0.7 ug/l expressed as aldrin. While this test was not specific as far as individual pesticides, the results of the test would include the total of such pesticides as aldrin, dieldrin, chlordane, DDT, etc. which are all composed of rather persistant chlorinated hydrocarbon bases.

The allowable concentrations of these materials from the standpoint of chronic toxicity range from 0.002 to 0.01 ug/l, depending on the specific pesticide involved. The concentrations in the effluent could manifest their presence by causing damage to any receiving stream with minimal dilution.

The tests for organo-sulfur and organo-phosphorus pesticides again included all of the pesticides included in the general grouping. These tests indicated the potential presence of two specific compounds--malathion and methyl parathion in the effluent. The total concentration of organo-sulfur pesticides was found to range from less than 0.1 ug/l to 77 ug/l with the average value approximately 28 ug/l as methyl parathion. Organo-phosphorus pesticide values ranged from 1.3 to 4.6 ug/l with an average of 2.8 ug/l expressed as methyl parathion.

As in the previous case, if it is assumed that the material is all methyl parathion, then the recommended allowable concentration listed in Water Quality Criteria would be 0.0004 ug/l. Again, one could expect that the compounds would have a detrimental effect on any receiving stream with minimal dilution.

However, the data collected by Hilsenhoff and Karl (1975) on macro-invertebrates and the data collected by Magnuson and Herbst (1975) on fish during their studies of Badfish Creek do not tend to confirm the fact that pesticides in the effluent are causing the level of damage that might be anticipated from the pesticide concentrations found.

Since it is an established fact that pesticides tend to adsorb to particulate matter, the pesticides in the effluent may be effectively removed from solution and concentrated in the bottom sediments along certain slow-moving sections of the stream.

Likewise, it could be anticipated that filtration of the effluent would also result in the increased removal of pesticides that may be adsorbed onto the suspended matter, thus greatly reducing the concentrations in the effluent.

As with the heavy metals, it is suggested that MMSD strive to locate the sources of pesticide discharges into their system. Relatively large quantities would have to exist in the influent in order to represent the total poundage levels left in the effluent since about 70% removal can be expected with secondary treatment. The search could begin with a scanning of the larger potential sources.

As in the case of mercury, one could suspect that agricultural use of pesticides might result in pesticide levels in agricultural run-off. A limited number of pesticide samples were collected on the Rutland Branch and Spring Creek during run-off conditions. Analysis of the samples confirmed the presence of 0.1 ug/l of chlorinated hydrocarbon pesticides in the waters of each stream.

In summary, while pesticides would appear to be a potential problem area, the extent of the problem cannot be fully defined without considerably more investigative work. Such work should include the gathering of pesticide data on both the receiving stream and suspected contributors in the sewer system.

Both the State and the Federal government are placing increasingly stricter controls on the manufacture, sale and use of all pesticide formulations. It would seem reasonable to assume that pesticide levels in the environment will naturally decline over the next few years.

With a reasonable assumption that pesticide levels in the tributary streams in the Madison area are of the same order of magnitude as those found in the sewage effluent; it would seem to be unjustified at this time to recommend higher levels of treatment specifically for the removal of pesticides. Therefore, no additional levels of treatment are recommended for this purpose.

(15) Polychlorinated Biphenyls

Certain phenolic compounds utilized in today's highly technical society have been found to have the same cumulative toxic properties in the environment as the chlorinated hydrocarbon pesticides and mercury. These compounds, referred to as polychlorinated biphenyls (PCB's), have the basic phenol structure with from one to ten attached chlorine atoms. The entire family could represent up to 200 possible compounds. PCB's are used as insulating electrical fluids, hydraulic fluids and plasticizers. Most of the known data on PCB's in the aquatic environment has been related to measuring concentration in the tissues of fish. High concentrations have been found in fish in the upper Hudson River in New York and in fish inhabiting the Great Lakes.

The U.S. Food and Drug Administration has established an allowable level of 5 ug/g for polychlorinated biphenyls in fish used as human food.

The 1972 edition of Water Quality Criteria recommends a limit of 0.5 ug/gram in fish and recommends allowable concentrations in the stream of less than 0.002 ug/l in order to prevent the build-up in fish tissues.

Since PCB's have an affinity for sediments, they are deposited in the stream sediments and enter the food chain from that point. Bottom feeding fish, therefore, can be expected to possess relatively higher concentrations than the game fish species.

PCB measurements made during the effluent characterization survey showed PCB levels in the effluent ranging from less than 0.001 ug/l to 0.803 ug/l with an average value of 0.195 ug/l. If one were to assume a background concentration of zero in the receiving stream, and the maintenance of an instream concentration of less than 0.002 ug/l, approximately 100 dilutions of the effluent would be required. The Wisconsin River would offer the required dilutions. However, data reported by Degurse and Duter of the DNR in their report entitled "Chlorinated Hydrocarbon Residues in Fish from Major Waters in Wisconsin", 1975 showed higher concentrations of PCB's present in carp and buffalo in Lake Wisconsin than were found in buffalo in the Rock River Basin. Therefore, the Wisconsin River would seem to be more severely affected by PCB's than the Rock River.

Governmental actions have been taken only recently to limit the manufacture, sale and use of PCB's and it is expected that these actions will result in a reduction of PCB levels in the future.

The low concentrations found in the effluent, while higher than allowable concentrations in the stream are nevertheless at such low values that treatment techniques for removal would be relatively inefficient. At the same time it is assumed that other sources of PCB's in the area would still maintain stream concentrations in excess of the allowable value. Additional treatment for the removal of PCB's is not recommended.

It is suggested, however, that MMSD attempt to locate PCB sources in their system and institute procedures whereby the PCB's would be controlled at their source.

(c) Impact on Water Uses

Section 5.01 F of MMSD's EA is an adequate summary of impacts of the proposed actions on water uses in Badfish Creek.

F. IMPACT ON BIOLOGICAL RESOURCES

1. Impact on Area of Nine Springs Sewage Treatment Plant

The area of wetlands adjacent to Nine Springs Sewage Treatment Plant is one sensitive natural area that could potentially be affected by the proposed actions. Earth moving operations required for construction of the treatment facilities would expose the soil and make it subject to erosion. Runoff from the site could carry and deposit the eroded soil into the adjacent areas, including the wetlands and into Nine Springs Creek. By utilizing recognized construction methods, such as providing adequate site drainage (e.g. settling ponds), this temporary impact will be minimized.

2. Impact on Biota in Badfish Creek and Yahara River

The most significant impacts on biological resources which could result from the proposed actions would be the potential impacts on the Badfish Creek and the Yahara River resulting from continued diversion of MMSD's wastewater to Badfish Creek. Implementation of the proposed actions would result in a substantial improvement in water quality in the Creek compared to present conditions. The improved water quality will provide a higher level of protection for fish and aquatic life and is expected to result in an improvement in the aquatic species present in the Creek.

Section 5.01 J of MMSD's environmental assessment summarizes impacts on biota. It should be pointed out that the actions proposed in this EIS involve ozonation for disinfection and no longer propose breakpoint chlorination and dechlorination. It is expected that adequate protection from ammonia toxicity would be afforded the aquatic biota in all reaches of the Creek.

G. IMPACT ON AIR RESOURCES

1. Impact on Air Quality

Section 5.01 H of MMSD's EA adequately addresses potential air quality impacts except that it does not indicate that temporary decreases in air quality are expected during expansion of the Nine Springs sewage treatment plant. These temporary effects would result from the operation of construction equipment and from increased truck traffic carrying additional equipment and supplies.

2. Impact on Noise

Noise impacts resulting from construction and operation of the expanded treatment facilities are expected to be minimal if MMSD adheres to the criteria they proposed in Volume II, Section 5 of their facilities plan.

3. Impact on Odors

Section 5.01 H of MMSD's facilities plan adequately addresses potential odor impacts.

H. IMPACT ON LAND USE

Potential impacts on land use are adequately summarized in Section 5.01 I of MMSD's EA.

I. IMPACTS ON DEMOGRAPHIC AND SOCIOECONOMIC FACTORS

The most significant impact in this category is a positive one and that is that adequate treatment plant capacity will be provided for the additional population expected in MMSD's service area.

J. IMPACT ON SENSITIVE MAN-MADE RESOURCES

1. Impact on Historical and Archaeological Resources

There are no sites listed on or eligible for the National Register of Historic Places which will be affected by the proposed actions. In a letter dated June 4, 1976, (Included in Appendix A) the State Historic Preservation Officer (SHPO) recommended that the area proposed for location of the expanded treatment plant be surveyed by a qualified archaeologist to determine whether any sites would be affected by treatment facility construction. MMSD hired a qualified archaeologist to perform this survey. After review of the survey the State Historic Preservation Officer in a letter dated August 31, 1977, stated that "the significance of this site in terms of expected archeological values is negligible and we do not feel that the site is eligible for inclusion on the National Register".

2. Impact on Open Spaces and Recreation

a. Impact on Open Spaces

The proposed actions will have no significant impact on open spaces since the actions are in accordance with regional land use and open space plans.

b. Impact on Recreation

Section 5.01 L of MMSD's EA discusses the impact of the proposed actions on recreation. As is indicated there, "The implementation of the proposed actions would provide an effluent of sufficient quality to permit the aesthetic enjoyment and recreational utilization of Badfish Creek to be regained".

3. Impact on Agriculture

The proposed actions are expected to have no significant effect on agriculture.

4. Impact on Energy Resources

Section 5.01 M of MMSD's EA discusses the expected impact of the proposed actions on energy consumption by MMSD. Until further study is completed it will not be known how redesign of the facilities to meet WDNR proposed effluent limits will affect total electrical energy consumption. However, it is expected that there will be a substantial increase as indicated in the above-referenced section.

K. ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSED ACTIONS BE IMPLEMENTED

Section 5.02 of MMSD's environmental assessment adequately summarizes significant short term impacts which cannot be avoided should the proposed actions be implemented.

Section 5.02 of MMSD's environmental assessment also summarizes adverse long term impacts which can be expected as a result of implementing the proposed actions. We would like to supplement that summary with some additional discussion related to water quality and quantity impacts.

Sectin 5.02 of MMSD's EA indicates that "Improved wastewater treatment would provide an effluent which would substantially meet the water quality criteria for various beneficial uses, as suggested in Water Quality Criteria, 1972 where practicable". Related to water quality, this EIS has evaluated the proposed actions primarily in regard to whether or not they would protect the fish and aquatic life of Badfish Creek and protect its recreational use. Although the facilities proposed do not provide as high a level of nitrification as those proposed in MMSD's facilities plan, we feel that they will adequately protect the fish and aquatic life of the Creek and will protect its recreational use. To insure that, we propose that MMSD implement a water quality monitoring approved by the WDNR and prior to and after start up of the new facilities program to determine whether the proposed effluent limits and facility design allow for meeting the water quality criteria for protection of fish and aquatic life, especially related to ammonia nitrogen. We also propose that MMSD implement a bioassay program approved by the WDNR and EPA to evaluate the effect improved water quality and the new facilities and having on fish and aquatic life in Badfish Creek, particularly whether the proposed effluent limit for ammonia adequately provides for protection of fish and aquatic life from ammonia toxicity. We also propose that MMSD design the facilities so that additional nitrification facilities can be constructed at a later date if the monitoring and bioassay programs show that they are warranted.

Section 5.02 of MMSD's EA also summarizes potential adverse water quantity impacts related to diversion of water out of the Upper Yahara River. Since the regulation of lake levels and flow augmentation proposed as a mitigative measure will require a comprehensive planning program out the scope of this project, it can only be assumed that MMSD will cooperate with other area agencies in assuring that such a program is implemented.

L. RELATIONSHIP BETWEEN LOCAL SHORT TERM USE OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

Refer to pages 5-12 and 5-13 of MMSD's EA for a summary discussion of this subject.

M. IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES WHICH WOULD BE INVOLVED IF THE PROPOSED ACTIONS SHOULD BE IMPLEMENTED

Refer to page 5-13 of MMSD's EA for a summary discussion of this subject.

CHAPTER 6

PUBLIC PARTICIPATION

Section 6 of MMSD's environmental assessment is an adequate summary of public participation related to this project prior to this Draft EIS.

APPENDIX A

TABLE A-1

ESTIMATED TREATMENT FACILITY COSTS FOR

ALTERNATIVES #1 AND #2

Construction Costs		
Upgrading Existing Facilities		$1,815,000
Liquid Treatment Facilities		
Blower Building No. 1 Modifications		5,000
Blower Building No. 2		1,500,000
Secondary Clarifiers		650,000
Rotating Biological Contactors		9,100,000
Filter Building		1,250,000
Filters		1,165,000
Filter Galleries		855,000
Railroad Spur and Chlorine Docks		110,000
Chlorinators		170,000
Effluent Holding Pond		500,000
Dechlorination Equipment		30,000
Major Conduits		1,300,000
Solids Treatment Facilities		
Gravity Thickeners		110,000
Flotation Thickeners		815,000
Digesters and Control Building		1,700,000
Utility Tunnel		220,000
Supernatant Drawoff Equipment		70,000
	Subtotal	$20,365,000

Table A-1 continued

Engineering (12%)		$2,450,000
Administration (0.5%)		105,000
Legal and Fiscal Costs (2.5%)		505.000
Contingency (25%)		5,085,000
	TOTAL	$28,510,000
PRESENT WORTH CONSTRUCTION COSTS		$20,850,000

Operation and Maintenance Costs

	ELECTRIC POWER	OTHER O & M
Upgraded Secondary Treatment	$310,000/yr	$935,000/yr
Advanced Waste Treatment	460,000/yr	350,000/yr
Digested Sludge Disposal	---	110,000/yr
Subtotal	$770,000/yr	$1,395,000/yr
Contingency (25%)	190,000/yr	345,000/yr
TOTAL	$960,000/yr	$1,740,000/yr
Present Worth 20-Year Operation	$19,380,000	$14,540,000
Total Present-Worth O & M 20-Year Operation	$23,920,000	

Salvage Values

Computed Salvage Value After 20-Year Operation (2001)	$11,850,000
Present Worth Values	2,180,000
TOTAL PRESENT WORTH	$42,590,000

Compiled from information presented in MMSD's Facilities Plan, Volume II, Tables E-3 and F-6

TABLE A-2

COSTS FOR PUMPING TO YAHARA RIVER (ALTERNATIVE #1)

A.	TRANSMISSION FACILITIES	
	52,000 L. F. of 72" PCCP @ $206/ft	$10,712,000
	Engineering, Legal and Administration 15%	1,606,000
	Contingencies 25%	2,678,000
	Total Capital Costs	$14,996,000
	Salvage Value of Pipeline	10,997,000
	Present worth of Capital Costs	$11,440,000
	Present worth of Salvage Value (pipeline)	-2,026,000
B.	OPERATION & MAINTENANCE COSTS	
	Annual O & M Costs for Pipeline	$ 16,000
	Present worth of Pipeline O & M	134,000
C.	PRESENT WORTH OF PIPELINE	$ 9,548,000
D.	MODIFICATION TO EXISTING PUMPING STATION	
	New Pumps, Motors & Electrical Equipment	$ 723,000
	Engineering, Legal and Administration @ 15%	108,000
	Contingencies @ 25%	181,000
	Total Capital	$ 1,012,000
	Present Worth of Modifications	770,000
E.	PRESENT WORTH OF LIFT STATION AND CONNECTION TO EFFLUENT PUMP STATION	
	Present worth of Capital Costs	$ 300,000 (1)
F.	O & M COSTS FOR PUMPING	
	Electrical Power Costs	$ 349,000
	Other O & M Costs	80,000 (1)
	Present worth of Electrical Power Costs	$ 3,410,000
	Present worth of Other O & M Costs	670,000
	Present worth of O & M	$ 4,080,000
G.	PRESENT WORTH OF SALVAGE VALUE (Pumping)	$ - 65,000 (1)
	TOTAL PRESENT WORTH OF CAPITAL AND O & M FOR PUMPING AND PIPELINE TO YAHARA RIVER	$14,633,000

(1) Courtesy: CH2M Hill

Present worth calculated in accordance with methods specified in CH2M Hill Report, Volume II, Appendix E.

Source: Volume V, Appendix F of MMSD's Facilities Plan

*TABLE A-3

COSTS FOR SPLIT PUMPING TO BADFISH AND YAHARA RIVER

(ALTERNATIVE #2)

A.	BOOSTER PUMP STATION	
	Pumps, motors and electrical equipment	$ 330.000
	Structure	654.000
	Total Construction	$ 984.000
	Engineering, Legal and Administration @ 15%	147.000
	Contingencies @ 25%	246.000
	Total Capital	$1,377,000
	Salvage Value	$ 342.000
	Present worth of Capital Costs	$1,051,000
	Present worth of Booster Station Salvage Value	- 63,000
	Present worth of Booster Station Capital Costs	$ 988,000
B.	PIPELINE	
	52,000 L.F. of 47" PCCP @ 115/LF	$5,980,000
	Engineering, Legal and Administration @ 15%	897,000
	Contingencies @ 25%	1,495,000
	Total Capital	$8,372,000
	Salvage Value	$6,139,000
	Present worth of Capital Costs	$6,387,000
	Present worth of Salvage Value	$1,131,000
C.	OPERATION & MAINTENANCE	
	Annual O & M Costs for Pipeline	$ 12,000
	Present worth of Pipeline O & M costs	100,000
D.	PRESENT WORTH OF PIPELINE	$5,356,000
E.	PRESENT WORTH OF EFFLUENT DITCH IMPROVEMENTS	305,000
F.	PRESENT WORTH OF LIFT STATION AND CONNECTION TO EFFLUENT PUMP STATION	
	Present worth of Capital Costs	$ 300.000 (1)
	Present worth of Salvage Value	-20,000
	Present worth for Lift Station	$ 280,000

Table A-3 continued

G. O & M COSTS FOR PUMPING TO BADFISH CREEK	
Power Costs	$ 351,000 (1)
Other O & M	150,000
Present worth	
Electrical power	$3,435,000
Other O & M	1,250,000
Present worth for Pumping to Badfish	$4,685,000
TOTAL PRESENT WORTH FOR EFFLUENT PUMPING FOR SPLIT DISCHARGE TO BADFISH CREEK AND YAHARA RIVER	$11,614,000

(1) Courtesy: CH2M Hill

Present worth calculated in accordance with methods specified in CH2M Hill Report, Volume II, Appendix E.

*Extracted from Volume V, Appendix F of MMSD's Facilities Plan

*TABLE A-4

COSTS FOR PUMPING TO BADFISH CREEK (ALTERNATIVE #3)

A.	LIFT STATION AND CONNECTION TO EFFLUENT PUMP STATION	
	Present worth of Lift Station	$ 300,000
	Present worth of salvage value	- 20,000 (1)
	Present worth of Lift Station	$ 280,000
B.	ANNUAL O & M COSTS (Including 25% Contingencies)	
	Electrical Power	$ 345,000
	Other O & M	80,000 (1)
	Present worth of O & M Costs	
	Electrical Power	$3,375,000
	Other O & M	670,000
	Present worth of O & M	$4,045,000
C.	PRESENT WORTH OF EFFLUENT DITCH IMPROVEMENT	$ 305,000
D.	TOTAL PRESENT WORTH FOR PUMPING TO BADFISH CREEK	$4,630,000

(1) Courtesy CH2M Hill Chapter II, Volume II

*Source: MMSD Facilities Plan, Volume V, Appendix F

APPENDIX B

Fishes - Nine Springs Creek, 1972-73*

AMIIDAE - BOWFIN

Bowfin, *Amia calva* Linnaeus

SALMONIDAE - TROUT

Rainbow trout, *Salmo gairdneri* Richardson
Brown trout, *Salmo trutta* Linnaeus

UMBRIDAE - MUDMINNOW

Central mudminnow, *Umbra limi* (Kirtland)

CYPRINIDAE - MINNOWS AND CARP

Carp, *Cyprinus carpio* Linnaeus
Brassy minnow, *Hybognathus hankinsoni* Hubbs
Golden shiner, *Notemigonus crysoleucas* (Mitchill)
Emerald shiner, *Notropis atherinoides* Rafinesque
Common shiner, *Notropis cornutus* (Mitchill)
Sand shiner, *Notropis stramineus* (Cope)
Spotfin shiner, *Notropis spilopterus* (Cope)
Bluntnose minnow, *Pimephales notatus* (Rafinesque)
Fathead minnow, *Pimephales promelas* Rafinesque
Creek chub, *Semotilus atromaculatus* (Mitchill)

CATOSTOMIDAE - SUCKER

White sucker, *Catostomus commersoni* (Lacepede)

ICTALURIDAE - FRESHWATER CATFISH

Black bullhead, *Ictalurus melas* (Rafinesque)
Yellow bullhead, *Ictalurus natalis* (Lesueur)
Brown bullhead, *Ictalurus nebulosus* (Lesueur)

ATHERINIDAE - SILVERSIDE

Brook silverside, *Labidesthes sicculus* (Cope)

GASTEROSTEIDAE - STICKLEBACK

Brook stickleback, *Culaea inconstans* (Kirtland)

PERCICHTHYIDAE - TEMPERATE BASS

White bass, *Morone chrysops* (Rafinesque)
Yellow bass, *Morone mississippiensis* Jordan and Eignmann

CENTRARCHIDAE - SUNFISH

Green sunfish, *Lepomis cyanellus* Rafinesque
Pumpkinseed, *Lepomis gibbosus* (Linnaeus)
Bluegill, *Lepomis macrochirus* Rafinesque
Smallmouth bass, *Micropterus dolomieui* Lacepede
Largemouth bass, *Micropterus salmoides* (Lacepede)

(con't)

PERCIDAE - PERCH

Yellow perch, Perca flavescens (Mitchill)

SCIAENIDAE - DRUM

Freshwater Drum, Aplodinotus grunniens Rafinesque

*Source: Wisconsin Department of Natural Resources

APPENDIX C

THE STATE HISTORICAL
SOCIETY OF WISCONSIN

816 STATE STREET / MADISON, WISCONSIN 53706 / JAMES MORTON SMITH, DIRECTOR

State Historic Preservation Office

June 4, 1976

Mr. Ralph McClurg
O'Brien and Gere Engineers, Inc.
1304 Buckley Road
Syracuse, New York 13201

SHSW 0279-76

Dear Mr. McClurg:

This letter is in response to your letter of May 25, 1976 concerning the potential impacts of the MMSD-201 Facilities Planning Study proposed action on historical and archeological resources (File 1533.002).

Since the existing pipeline route and discharge to Badfish Creek will be utilized in the future, these actions will have no impact on sites or structures of historical or archeological significance. Additionally, the application of sludge to agricultural lands will have no effect on any historical or archeological sites.

The area designated in Figure 13-4, as the recommended location for an expanded treatment plant, should be surveyed by an archeologist to determine if any such sites will be affected by the proposed construction. Dr. Joan Freeman (608/262-9566), State Archeologist and a member of our staff, will be pleased to help you locate a qualified person to perform this survey.

Sincerely,

James Morton Smith
State Historic Preservation Officer

JMS:cm

THE STATE HISTORICAL SOCIETY OF WISCONSIN
816 STATE STREET / MADISON, WISCONSIN 53706

MADISON METROPOLITAN SEWERAGE DISTRICT
RECEIVED
SEP 1 1977

August 31, 1977

Mr. W. J. Landwehr, Chief Engineer and Director
Madison Metropolitan Sewerage District
104 North First Street
Madison, Wisconsin 53704

SHSW: 0279-76
RE: Nine Springs Sewerage District

Dear Mr. Landwehr:

Our staff archeologists have reviewed the "Report of an Archaeological Survey on the Site of the Proposed Expansion of the Nine Springs Sewage Treatment Plant, Madison, Wisconsin" by Dr. James B. Stoltman of the University of Wisconsin-Madison.

During the course of the survey one archeological site was located within the project area. The survey and testing procedures indicated that the archeological materials recovered from this site were excessively disturbed, and restricted to the plow zone. As a result of the excessive soil disturbance by agricultural activities, the significance of this site in terms of expected archeological values is negligible and we do not feel that the site is eligible for inclusion on the National Register.

Therefore, under the provisions of 36 CFR 800, we conclude that the construction of the Nine Springs Sewage Treatment Plant will have no effect upon properties listed on or eligible for inclusion on the National Register of Historic Places.

Sincerely,

Richard A. Erney
State Historic Preservation Officer

By Jeff Dean
State Preservation Planner

RAE:rdd

cc: Mr. George R. Alexander, Jr., Environmental Protection Agency
Dr. James B. Stoltman, Department of Anthropology
Mr. John Hario, Department of Natural Resources

APPENDIX D

REFERENCES

Chapter 1

Madison Metropolitan Sewerage District, Facilities Plan, 1976, Volume I, Summary Plan, Section 1

Chapter 2

Section A

Madison Metropolitan Sewerage District (MMSD), Facilities Plan, 1976, Volume 1, Environmental Assessment, Section 2.02 and Volume IV, Appendix A.

Section B

MMSD, Facilities Plan, 1976, Volume I, Environmental Assessment, Section 2.05, and Volume IV, Appendix A.

Section C

MMSD, Facilities Plan, 1976, Volume I, Environmental Assessment, Section 2.05, and Volume IV, Appendix A.

Section D

1. MMSD, Facilites Plan, 1976, Volume I, Summary Plan, Sections 2,3 and 6, Environmental Assessment, Sections 1 and 2; Volume IV, Appendices A, B, C, F and H.

2. Mackenthun, K.M. et al. A Study of the Effects of Diverting the Effluent from Sewage Treatment upon the Receiving Stream, Wisconsin Academy of Science Arts and Letters, Volume 49, 1960.

Section E

1. MMSD, Facilities Plan, 1976, Volume I, Environmental Assessment Section 2; Volume IV, Appendices A, B, D, and E.

2. Wisconsin Department of Natural Resources, unpublished Mud Lake Marsh Study cover map and open file information.

Section F

1. MMSD, Facilities Plan, 1976, Volume I, Environmental Assessment, Section 2; Volume IV, Appendix A.

2. United States Environmental Protection Agency, Quality of Life Indicators in U.S. Metropolitan Areas - 1970 A Comprehensive Assessment, Washington, D.C., 1975

Section G

MMSD, Facilities Plan, 1976, Volume I, Summary Plan, Section 6 and Environmental Assessment, Section 2; Volume IV, Appendix A, Section 2.

Section H

MMSD, Facilities Plan, 1976, Volume I, Summary Plan, Sections 5 and 6 and Environmental Assessment, Section 2; Volume IV, Appendix A, Section 2; Volume VI, Appendices K and N

Section I

1. MMSD, Facilities Plan, 1976, Volume I, Summary Plan, Section 6 and Environmental Assessment, Section 2; Volume II, Section 5; Volume IV, Appendix A

2. Upper Mississippi River Comprehensive Basin Study, Volume VI, Appendix M: Power, 1970

Chapter 3

Section B

Madison Metropolitan Sewerage District (MMSD), Facilities Plan, 1976, Volume I, Summary Plan, Sections 7 and Environmental Assessment, Section3; Volume V, Appendix F

Section C

MMSD, Facilities Plan, 1976, Volume I, Summary Plan, Section 8 and Environmental Assessment, Section 3; Volume VC, Appendices F and I.

Section D

1. MMSD, Facilities Plan, 1976, Volume I, Summary Plan, Sections 7 and 8 and Environmental Assessment, Section 3; Volume II, Volume IV, Appendices A, C, D, E; Volume V, Appendices F, H, I

2. MMSD letter to USEPA, Region V dated August 24, 1977

3. USEPA , Washington, D.C. Quality Criteria for Water, 1976, EPA-440/9-76-023

4. WDNR memo dated, April 4, 1977, May 3, 1977, July 21, 1977 and July 22, 1977

Chapter 4

Madison Metropolitan Sewerage District, Facilities Plan, 1976, Volume

I, Summary Plan, Section 9 and Environmental Assessments, Section 4

Chapter 5

Sections B, C, and D

Madison Metropolitan Sewerage District (MMSD), Facilities Plan, 1976, Volume I, Environmental Assessment, Section 5

Section E

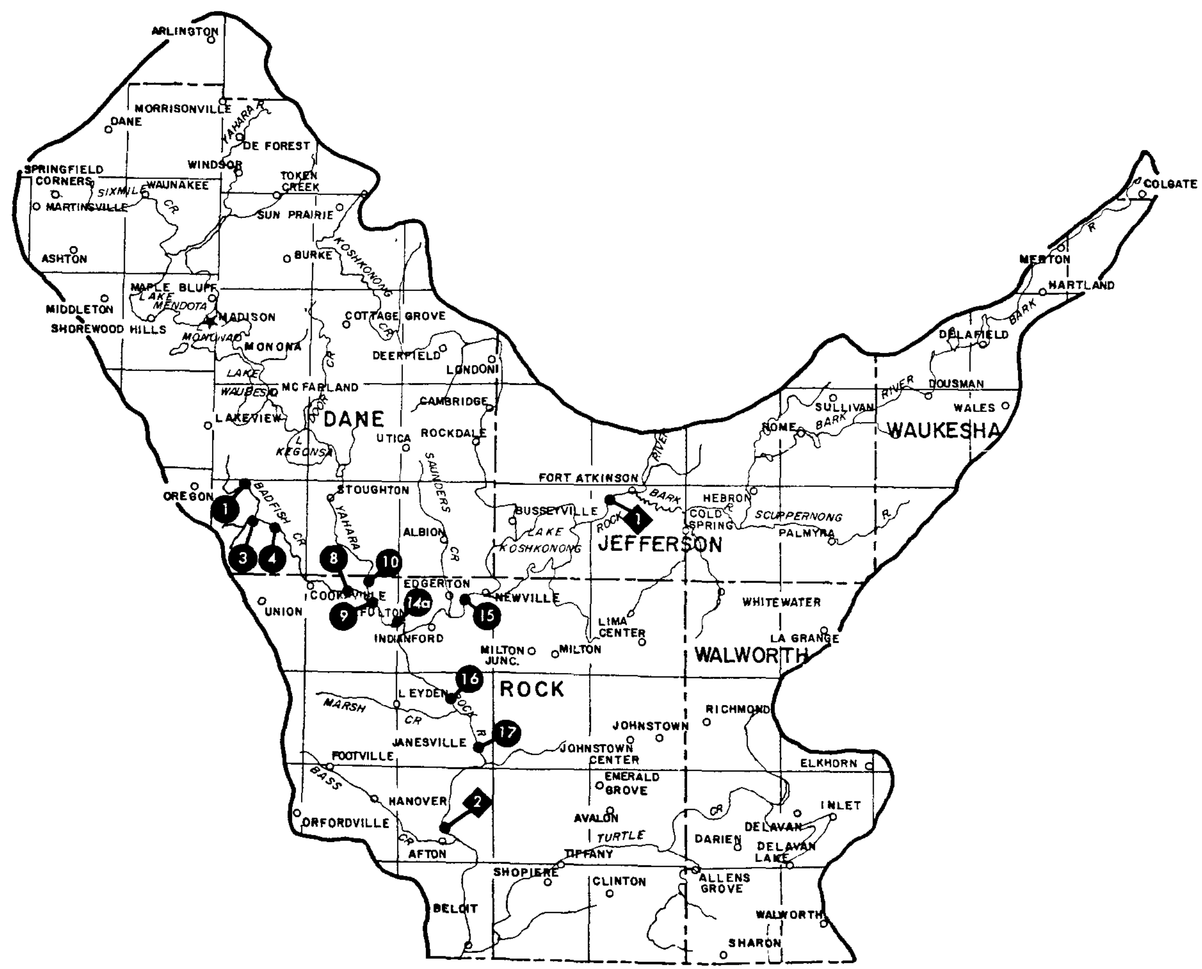
1. Mackenthun, K.M., et al. A Study of the Effects of Diverting the Effluent from Sewage Treatment Upon the Receiving Stream, Wisconsin Academy of Sciences, Arts and Letters, Volume 49, 1960

2. MMSD, Facilities Plan, 1976, Volume I, Summary Plan and Environmental Assessment, Section 5; Volume V, Appendix F, Sections 3, 4 and 5;

3. WDNR memos dated April 14, 1977; May 3, 1977; July 21, 1977 and July 22, 19771

Chapter 6

MMSD Facilities Plan, 1976, Volume I, Environmental Assessment, Section G



SOURCE: MMSD FACILITIES PLAN VOLUME IV, APPENDIX A

FIGURE 2-2

MMSD FACILITIES PLAN

WATER QUALITY MONITORING STATIONS LOWER ROCK RIVER BASIN

LEGEND:

○ SELECTED MMSD MONITORING STATION

◇ WISC DNR MONITORING STATION

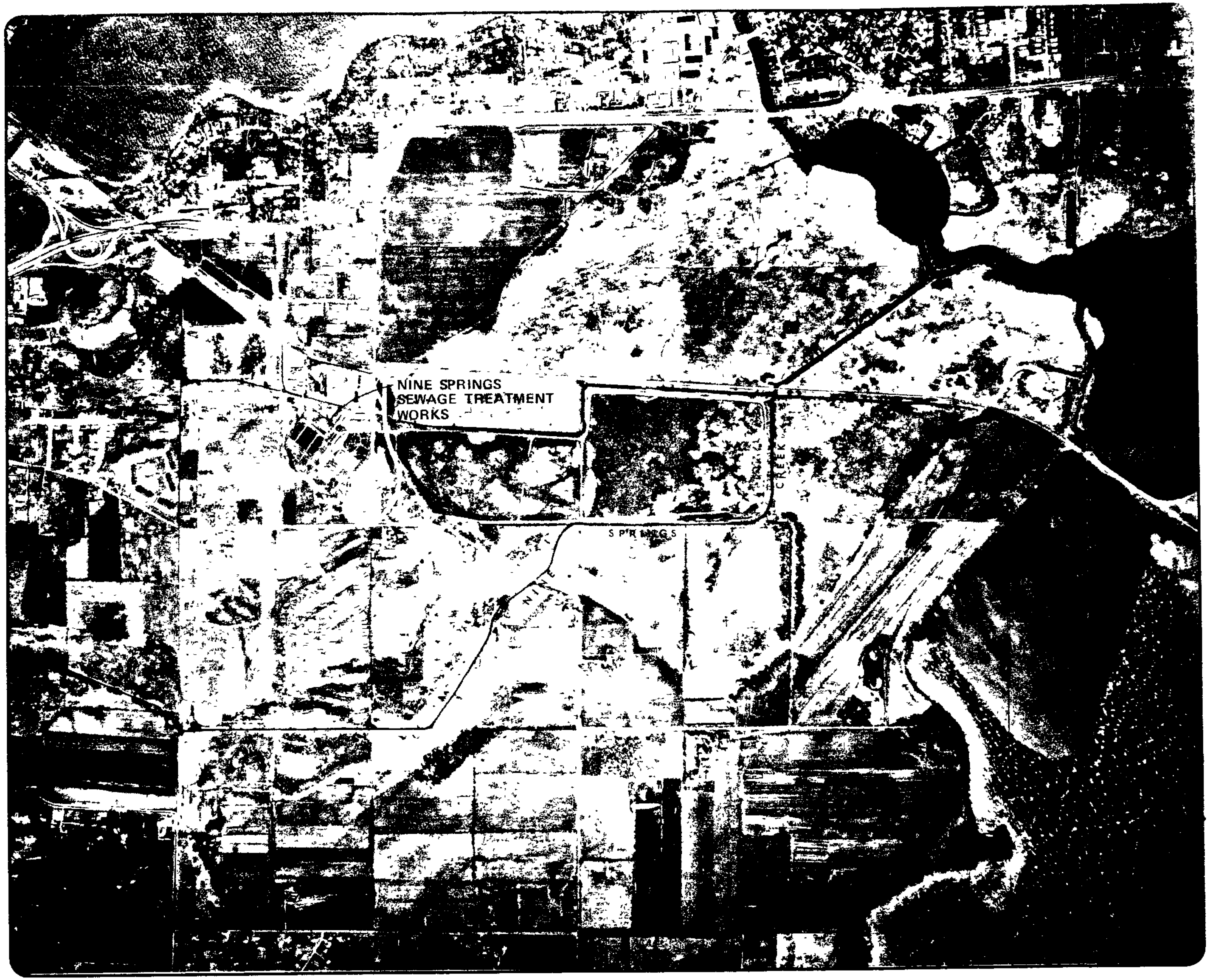


FIGURE 2-6

*BASE MAP OF THE NINE SPRINGS SEWAGE TREATMENT PLANT AREA

*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan and Adapted for Use in this Report.

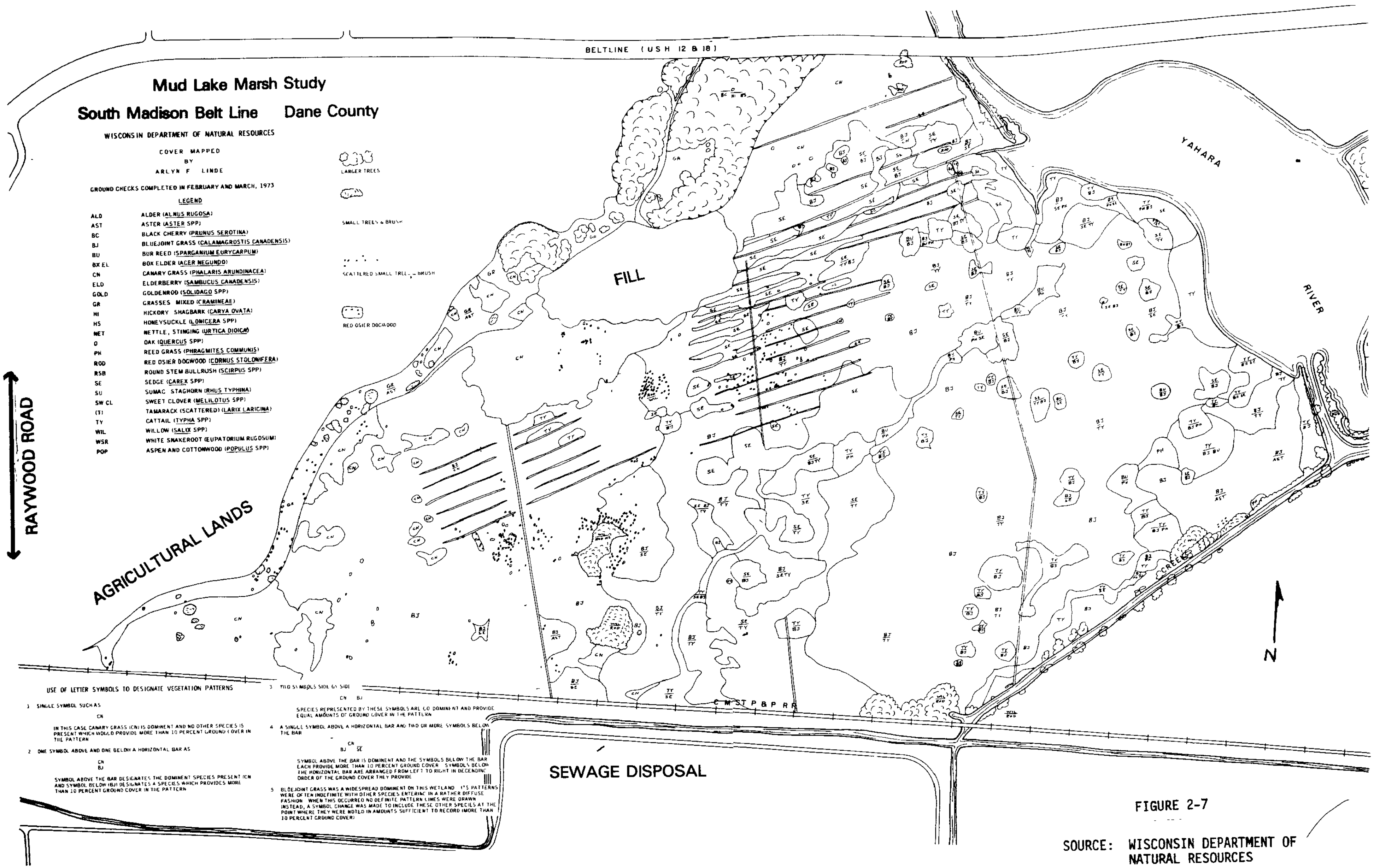
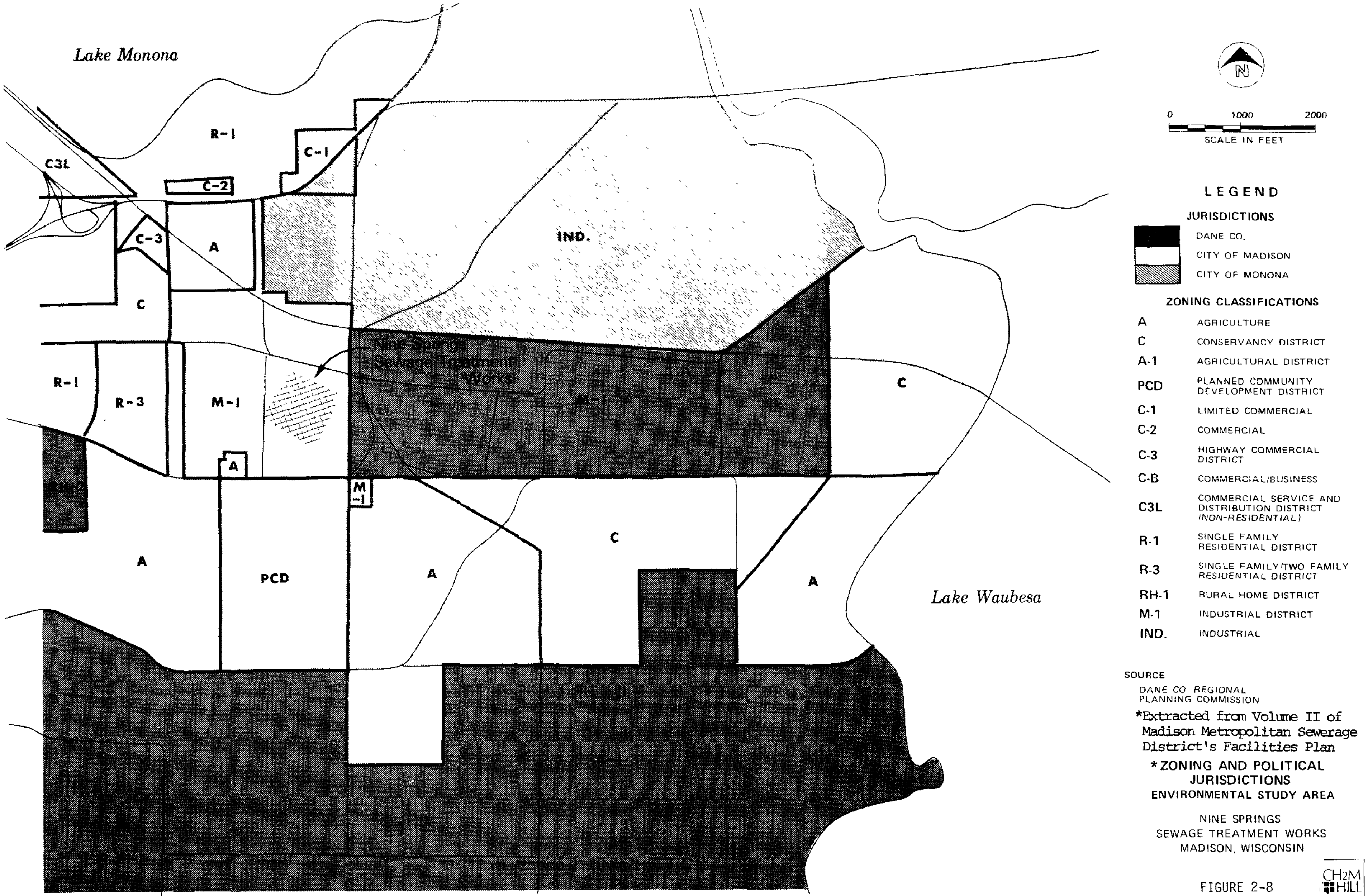


FIGURE 2-7

SOURCE: WISCONSIN DEPARTMENT OF NATURAL RESOURCES



SOURCE
DANE CO REGIONAL PLANNING COMMISSION

*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan

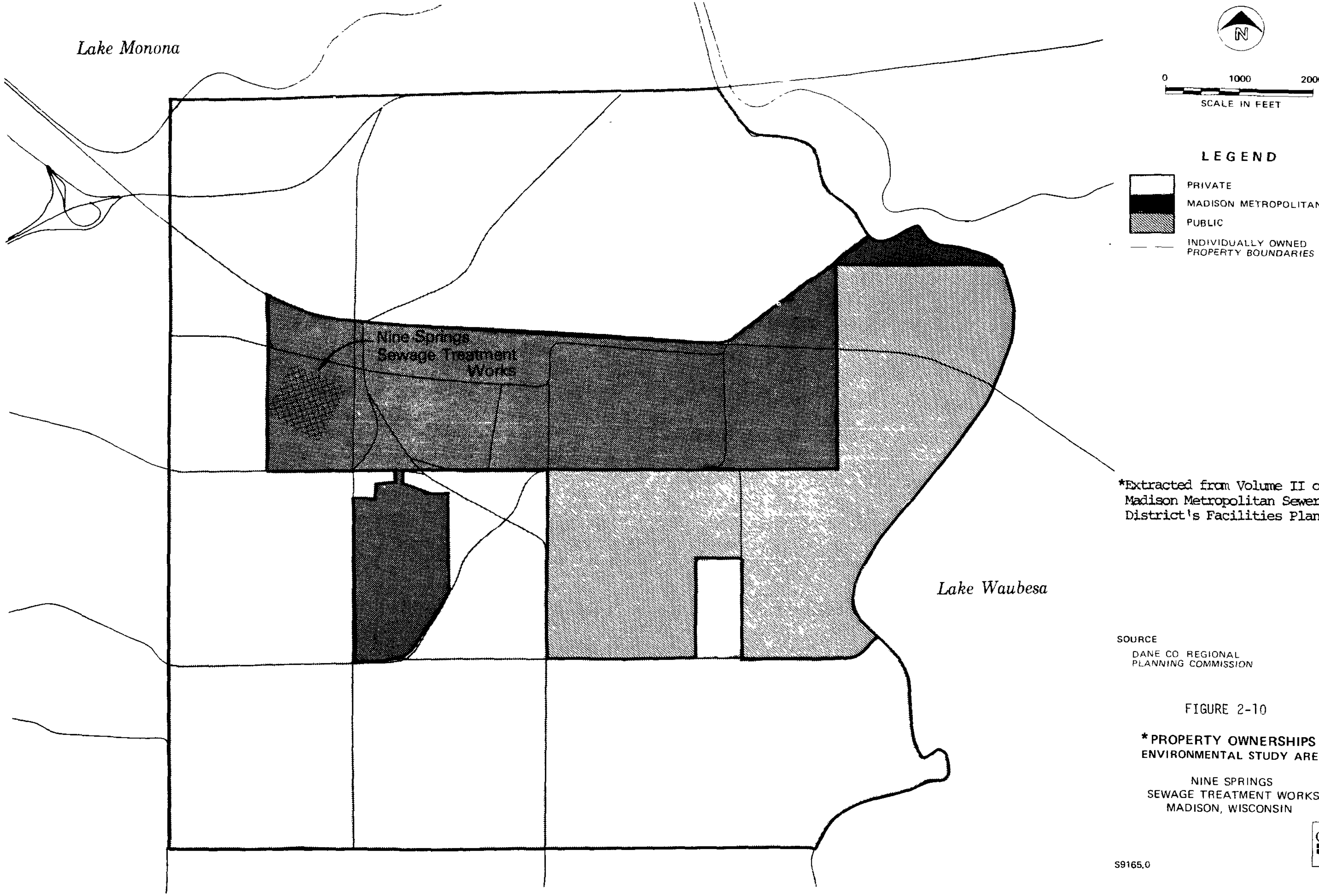
***ZONING AND POLITICAL JURISDICTIONS**
ENVIRONMENTAL STUDY AREA

NINE SPRINGS
SEWAGE TREATMENT WORKS
MADISON, WISCONSIN

FIGURE 2-8

CH2M HILL

S9165.0



*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan

SOURCE
DANE CO REGIONAL PLANNING COMMISSION

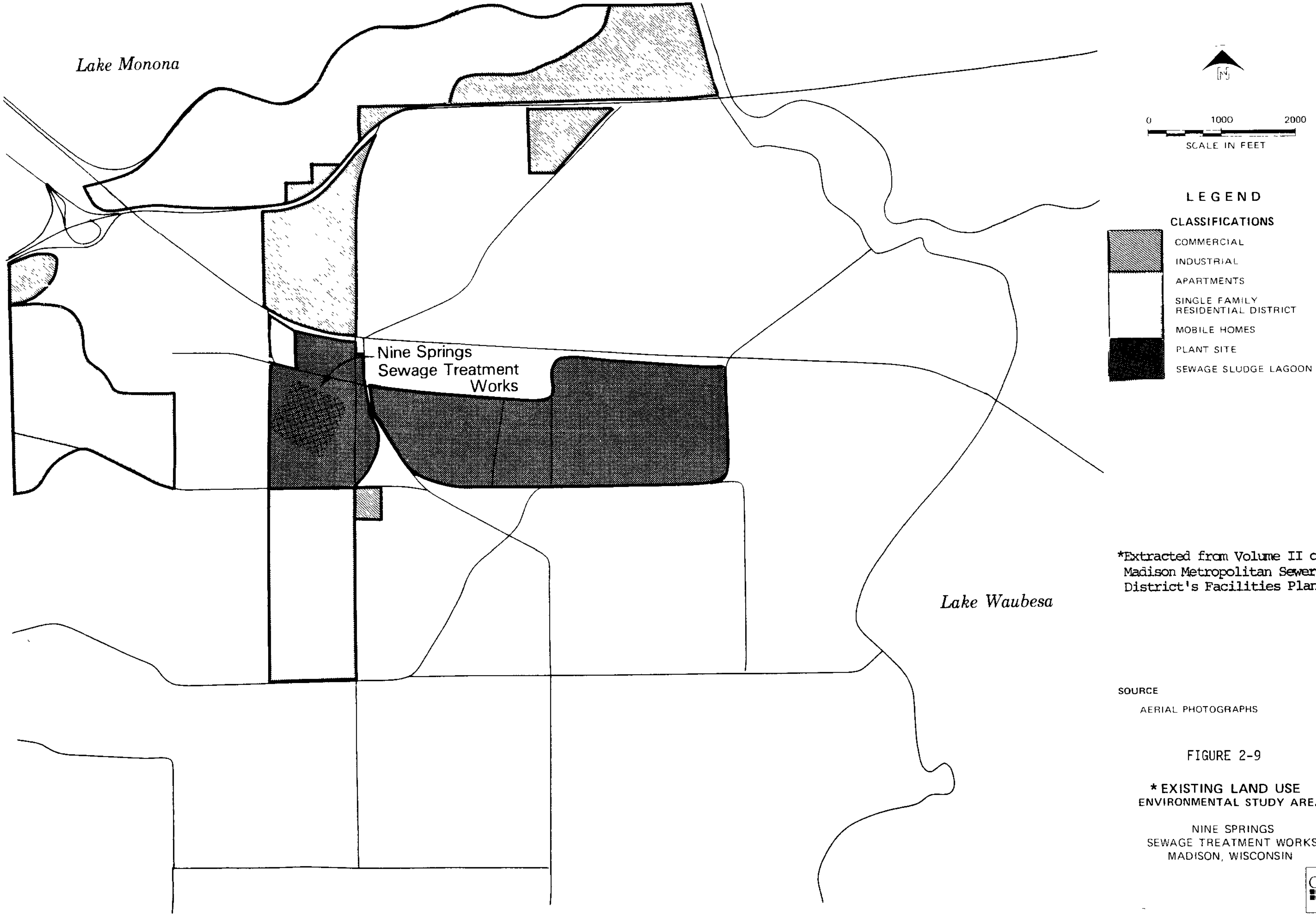
FIGURE 2-10

***PROPERTY OWNERSHIPS**
ENVIRONMENTAL STUDY AREA

NINE SPRINGS
SEWAGE TREATMENT WORKS
MADISON, WISCONSIN

CH2M HILL

S9165.0



*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan

SOURCE

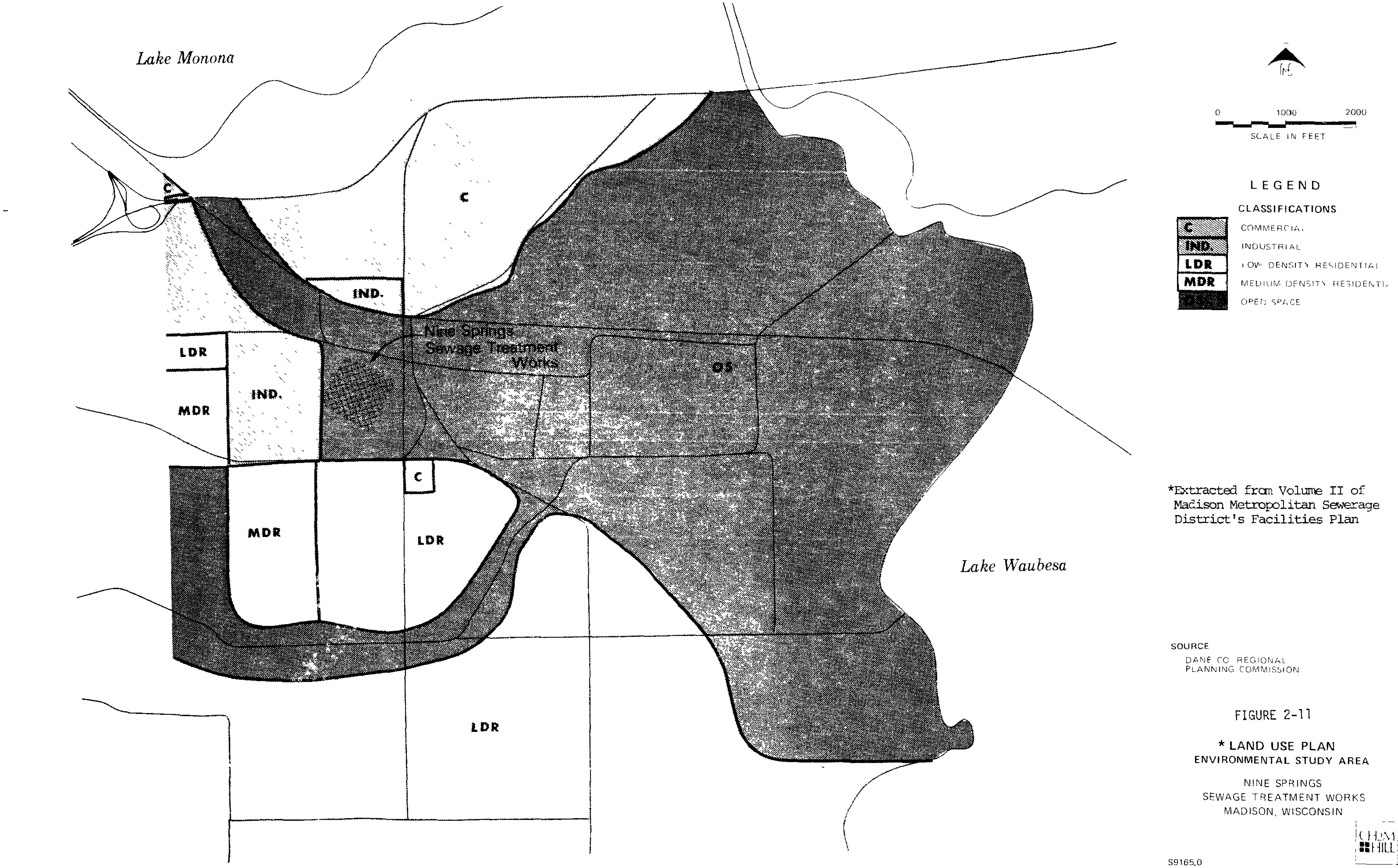
AERIAL PHOTOGRAPHS

FIGURE 2-9

*** EXISTING LAND USE**
ENVIRONMENTAL STUDY AREA

NINE SPRINGS
SEWAGE TREATMENT WORKS
MADISON, WISCONSIN

CH2M HILL



*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan

SOURCE
DANE CO. REGIONAL PLANNING COMMISSION

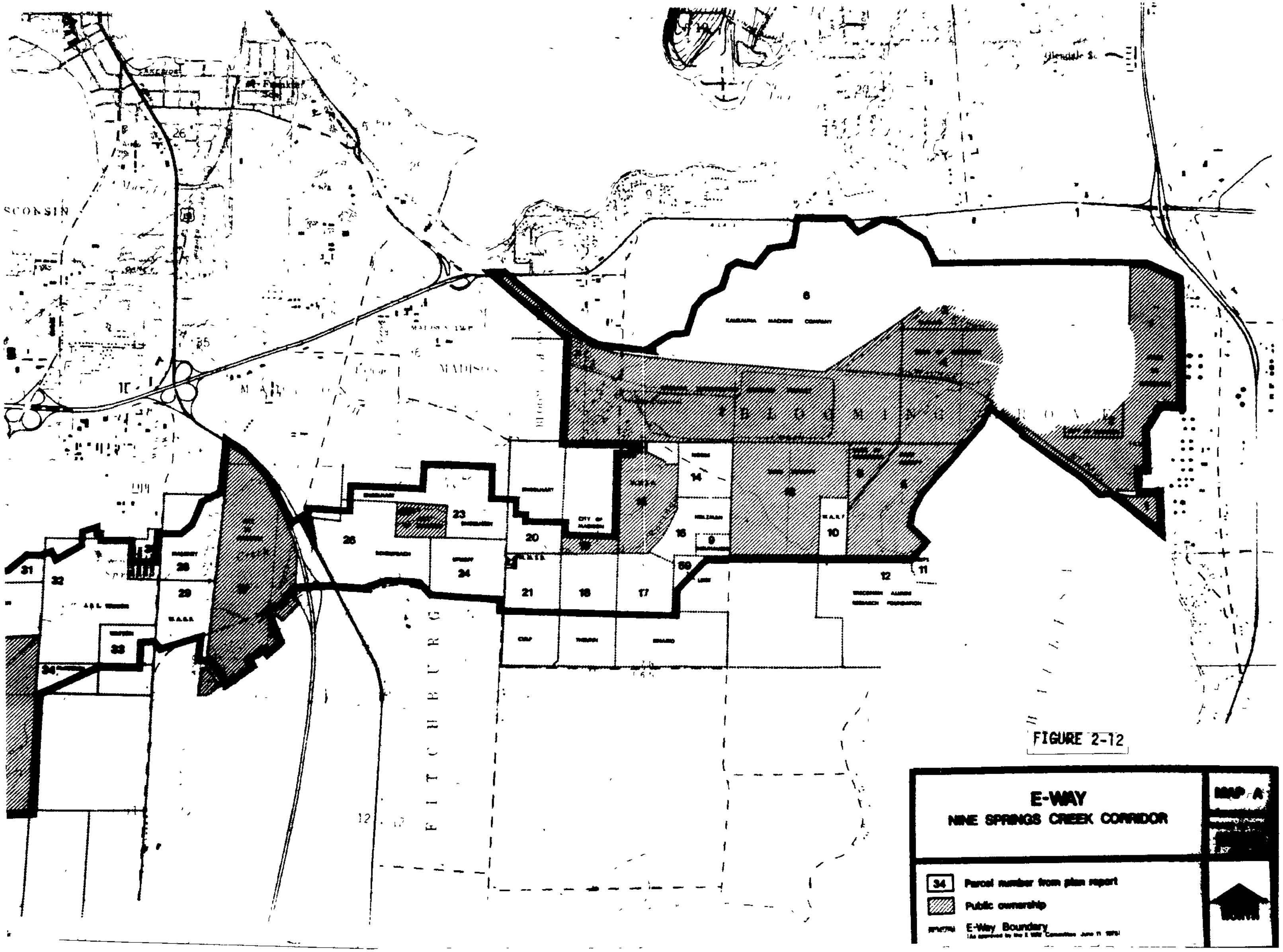
FIGURE 2-11

*** LAND USE PLAN**
ENVIRONMENTAL STUDY AREA

NINE SPRINGS
SEWAGE TREATMENT WORKS
MADISON, WISCONSIN

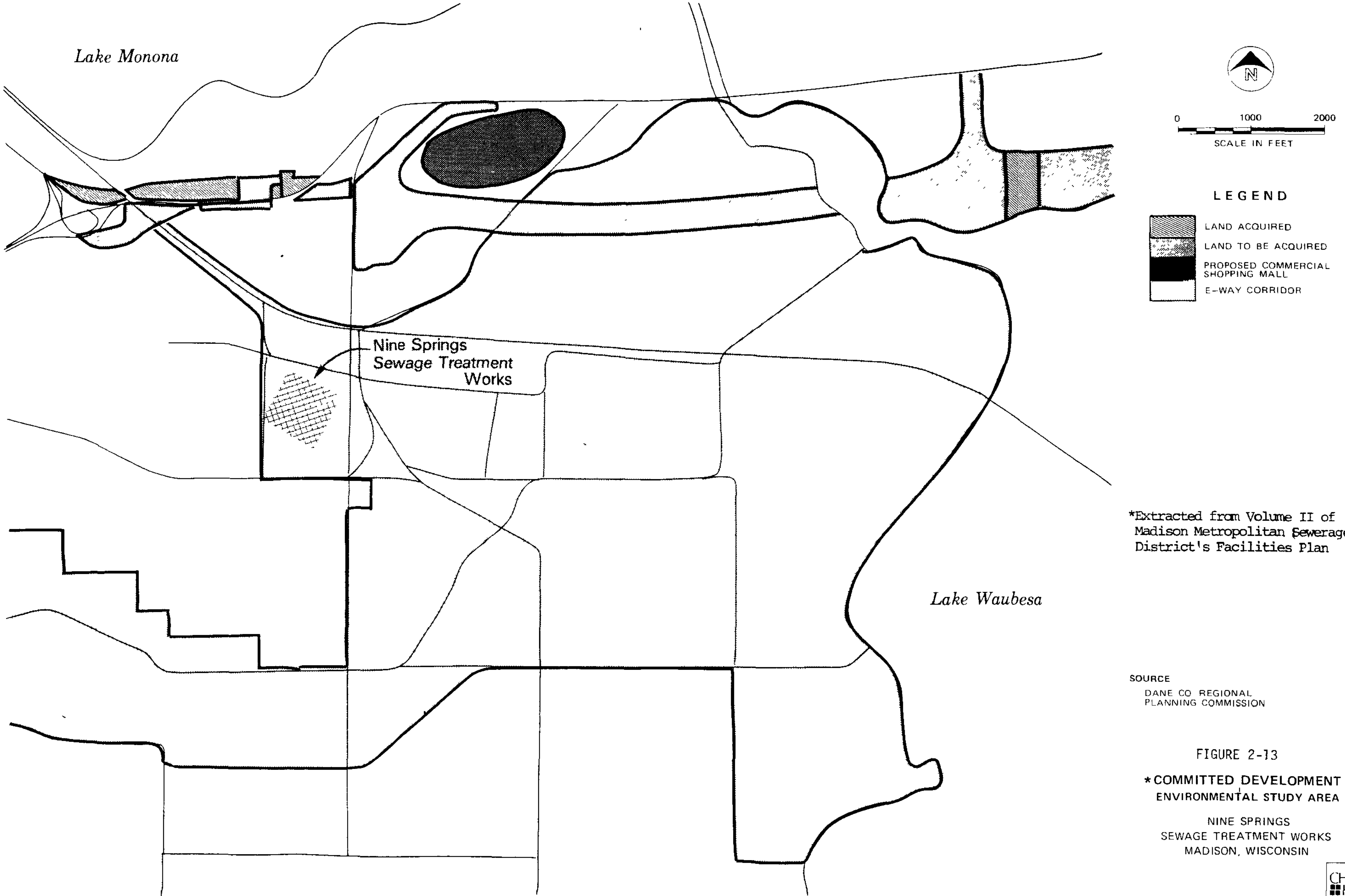
CH2M HILL

S9165.0



E-WAY
NINE SPRINGS CREEK CORRIDOR
MAP A
Parcel number from plan report
Public ownership
E-Way Boundary
KAISHAUPAN MACHINE COMPANY
CITY OF MADISON
BLOOMING GROVE
FITCHBURG
MADISON

FIGURE 2-12



*Extracted from Volume II of Madison Metropolitan Sewerage District's Facilities Plan

SOURCE
DANE CO REGIONAL PLANNING COMMISSION

FIGURE 2-13

*COMMITTED DEVELOPMENT
ENVIRONMENTAL STUDY AREA

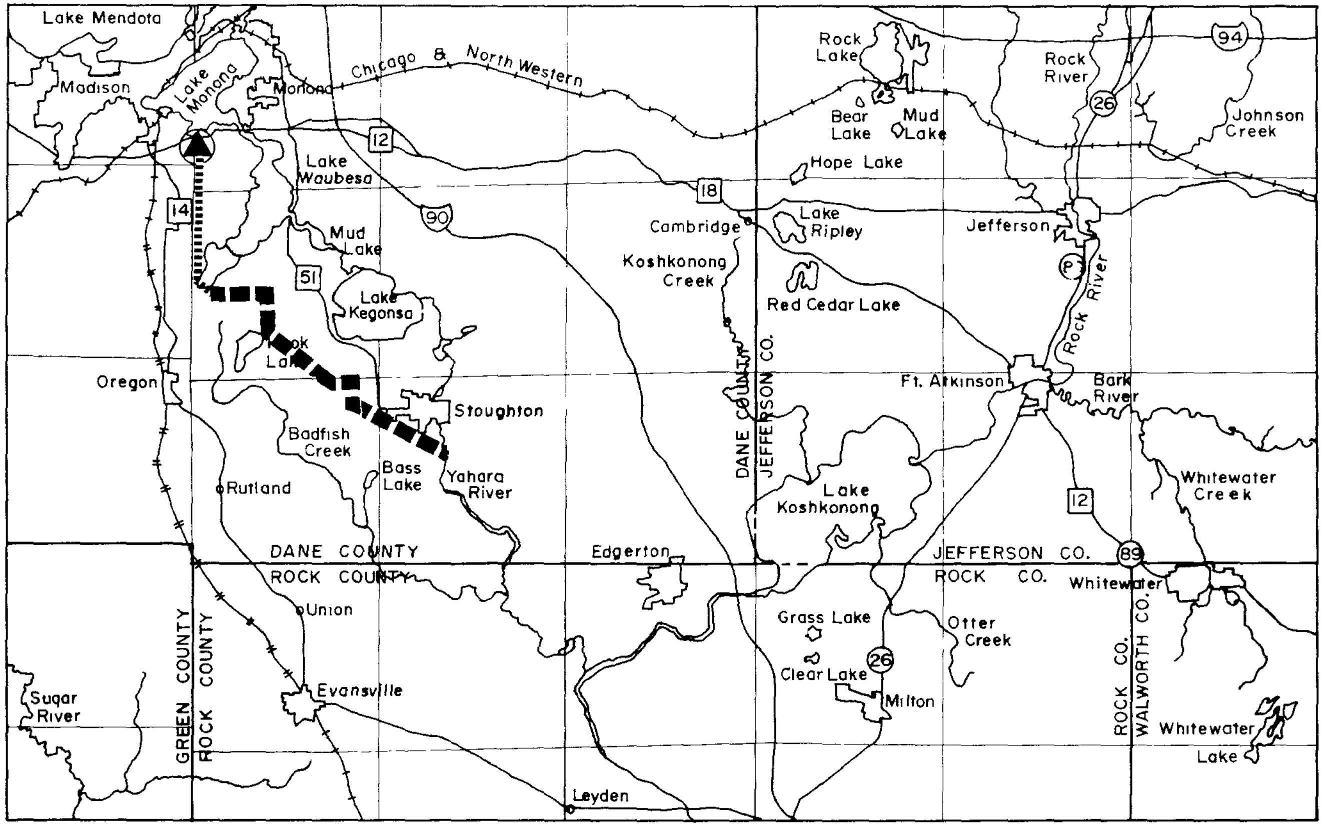
NINE SPRINGS
SEWAGE TREATMENT WORKS
MADISON, WISCONSIN

CH2M HILL

S9165.0

FIGURE 3-1

FORCE MAIN ROUTING TO YAHARA RIVER
FOR ALTERNATIVES #1 AND #2



SOURCE: MMSD FACILITIES PLAN
SUMMARY PLAN, FIGURE8-8

LEGEND:

- NINE SPRINGS WASTEWATER TREATMENT PLANT
- EXISTING 54" FORCE MAIN
- NEW 72" FORCE MAIN OR NEW 48" FORCE MAIN

ALTERNATIVE #1
UTILIZES EXISTING FORCE MAIN AND NEW 72" FORCE MAIN TO YAHARA RIVER

ALTERNATIVE #2
UTILIZES EXISTING FORCE MAIN AND EFFLUENT DITCH TO BADFISH CREEK AND NEW 48" FORCE MAIN TO YAHARA RIVER

O'BRIEN & GERE ENGINEERS, INC

Table 3-7
Summary Comparison of Final Alternatives
And "No Action" Alternative

Categories of Comparison	Yahara River Discharge Alternative #1	Split Discharge to Badfish Creek-Yahara River Alternative #2	Continued Discharge to Badfish Creek Alternative #3	'No Action'
* Present-worth cost (total)	$57,223 000 More costly than either of the other alternatives	$54,204,000 Significantly more costly than alternative #3 and also more costly than #1	$44,220,000 $47,220,000 Significantly less costly than other alternatives	N/A
* Ability to meet receiving stream water quality goals and objectives	Standards for full protection of fish and aquatic life cannot be consistently met in the Yahara River	Standards for full protection of fish and aquatic life cannot be consistently met in the Yahara River Full protection of fish and aquatic life can be consistently provided in the Badfish Creek	Standards for full protection of fish and aquatic life are expected to be met in all reaches of Badfish Creek	Modeling of "No Action" alternative was not completed However, it is expected that a low level of protection of fish and aquatic life & recreation will be maintained
Environmental Impact				
Impacts resulting from treatment plant and pump station construction	No Significant Difference Between Alternatives (NSDBA)	NSDBA	NSDBA	No impact
* Impacts resulting from pipeline installation and effluent ditch maintenance	Short term (less than 5 years) temporary construction impacts, erosion, dust, traffic impediments <u>Irretrievable</u> Commitment of energy, material and manpower resources Greater than for Alternative #2 <u>Continuing Impacts</u> Since the effluent ditch and Badfish Creek are not used in this alternative, maintenance of ditch and Creek will not be required They will be allowed to revert to more natural conditions over time	Short term (less than 5 years) temporary construction impacts erosion, dust traffic congestion <u>Irretrievable</u> Commitment of energy material and manpower resources Less than for alternative #1 <u>Continuing Impacts</u> Continued maintenance of effluent ditch and Badfish Creek will perpetuate their artificially structured condition	Short term (less than 5 years) continued use of existing pipeline so impacts of new construction <u>will be avoided</u> <u>Irretrievable</u> Since an existing pipeline will be used no further commitment of resources will be required for construction <u>Continued Impacts</u> Continued maintenance of effluent ditch and Badfish Creek will perpetuate their artificially structured condition	Continuing Impacts continued maintenance of effluent ditch and Badfish Creek will perpetuate their artificially structured condition
Impacts Resulting from Operation of the Treatment Plant and Pumping and Transmission Facilities				
Water Quality Impacts <u>Dissolved Oxygen</u>	Will not consistently meet level of 5 mg/l D O in Yahara River Taking effluent out of Badfish will provide low D O in Badfish initially with D O level increasing eventually as sediment oxygen demand decreases	<u>Will not</u> consistently meet level of 5 mg/l D O in Yahara River Level of 5 mg/l D O will be maintained in Badfish Creek	<u>Will</u> consistently meet level of 5 mg/l D O in Badfish Creek	Expected D O level is unknown However, by end of planning period we feel that the level of D O in all reaches of Badfish Creek will be less than 5 mg/l during low flow
<u>Temperature</u>	No significant temperature impact on Yahara River Taking discharge out of Badfish Creek will probably decrease net temperature of Creek However temp is not considered to be the significant factor controlling biota	No significant temperature impact on Yahara River Continued discharge to Badfish Creek will perpetuate warm water conditions, but temperature is not considered to be the significant factor controlling biota	Is expected to perpetuate existing warm water conditions but temperature is not considered to be the significant factor controlling biota present	It is expected that existing warm water conditions will be perpetuated However, temperature is not considered to be the significant factor controlling the biota present
* <u>Ammonia Nitrogen</u>	Will meet limits recommended for protection of aquatic life from toxicity standpoint	Will meet limits recommended for protection of aquatic life from toxicity standpoint	Will meet limits recommended for protection of aquatic life from toxicity standpoint in downstream reaches of Badfish Creek Levels which will be met upstream are not known however they are expected to be within applicable standard	Expected to provide conditions toxic to aquatic organisms from an ammonia toxicity standpoint
<u>Residual Chlorine</u>	Levels of chlorine will be within limits protecting receiving stream from toxicity Potential for toxicity only if system not properly managed	Levels of chlorine will be within recommended limits Potential for toxicity only if system not properly managed	Ozonation used, so no chlorine residual No potential for chlorine toxicity if system is not properly managed	Potential for residual chlorine toxicity would exist
<u>Heavy Metals, Pesticides PCB's, Cyanides, Suspended solids, Total Dissolved Solids</u>	NSDBA	NSDBA	NSDBA	Higher levels of these substances will remain in effluent compared to other alternatives with higher potential for toxicity to aquatic organisms
* Impact on Water Balance In Area Streams	Requires least flow augmentation for upper Yahara River	Requires intermediate level of flow augmentation for upper Yahara River	Requires greatest flow augmentation for upper Yahara River	Requires greatest flow for upper Yahara River
Impact on Use of Surrounding Lands	No significant effect on the use of lands surrounding receiving stream	No significant effect on the use of lands surrounding receiving streams	Expected to cause minimal damage and have minimal impact on use of lands surrounding receiving stream	Expected to cause minimal damage and have minimal impact on use of lands surrounding receiving stream Hook-ups to system may have to be curtailed with resultant restrictions on population growth and land use
Impact on Air Quality	NSDBA	NSDBA	NSDBA	As treatment facilities become overloaded, odor problems are expected As effluent quality decreases stream odor problems are expected to increase
Impact on Energy Consumption	NSDBA	NSDBA	NSDBA	Less energy will be consumed than for other alternatives
System Reliability	NSDBA	NSDBA	NSDBA	Facilities are expected to become overloaded and in some cases may not function by the end of the planning period
System Flexibility	NSDBA	NSDBA	NSDBA	Since these facilities will not meet present requirements, greater changes would have to be made if stricter requirements are made at a later date

* Indicates categories showing considerable difference between alternatives