INSTRUCTIONS FOR ADDING REVISION 12
TO THE MIDLAND PLANT
ENVIRONMENTAL REPORT

This Revision 12 to the Environmental Report (ER) of the Midland Plant consists of pages that are to be inserted into your copy of the ER.

Vertical bars in the margin indicate the location of the revisions in text and tables. Pages without bars are either unchanged pages furnished for continuity or contain minor spelling or editorial corrections which do not change the text content. The pages to be removed and inserted are as follows:

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i thru v	i thru iv
After Tab, LOEP-1 thru LOEP-11	After Tab, LOEP-1 thru LOEP-31
1-i/1-ii	1-i/1-ii
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Tbl 1.1-7 thru Tbl 1.1-14	Tbl 1.1-7 thru Tbl 1.1-14
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Fig 2.1-13	-------
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2.2-1 thru 2.1-24	2.2-1 thru 2.2-24
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App 2.2B	-------
App 2.2C	-------
2.4-1 thru 2.4-25	2.4-1 thru 2.4-25
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2.4R-1 thru 2.4R-3	2.4R-1 thru 2.4R-3
Tbl 2.5-1	Tbl 2.5-1
Fig 2.5-5	Fig 2.5-5

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Volume 2

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3.1-5/3.1-6	3.1-5/3.1-6
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3.7-[illegible] thru 3.7-5	3.7-2a thru 3.7-5
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3.9-1 thru 3.9-15	3.9-1 thru 3.9-15
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4.1-3/4.1-4	4.1-3/4.1-4
4.1R-1	4.1R-1
4.2-1 thru 4.2-9	4.2-1 thru 4.2-11
---------	Tbl 4.2-2 (1 of 3) thru Tbl 4.2-2 (3 of 3)
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4.3-1 thru 4.3-6	4.3-1 thru 4.3-6
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5-i/5-ii	5-i/5-ii
5.1-1 thru 5.1-21	5.1-1 thru 5.1-20
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App 5.1A-3	App 5.1A-3
5.6-1 thru 5.6-5	5.6-1 thru 5.6-8
5.6R-1	5.6R-1/5.6R-2
5.7-1/5.7-2	5.7-1/5.7-2

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Fig 3.9-3C	0
Fig 3.9-3D	0
Fig 3.9-3E	0
Fig 3.9-3F	0
Fig 3.9-3G	0
Fig 3.9-3H	0
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4.2R-2	12
4.3-1	12
4.3-2	12
4.3-3	12
4.3-4	12
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4.3-6	12
4.3R-1	12
4.4-1	0
4.4-2	1
Tbl 4.4-1	0
4.4R-1	0
4.5-1	0
4.5R-1	1
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Tbl 5.1B-2	0
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NA = Not applicable. This appendix was not written by Consumers Power Company or its contractors.

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NA = Not applicable. This appendix was not written by Consumers Power Company or its contractors.

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App A (2 of 2)	0
App B Title Pg	0
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App C Title Pg	0
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Fig 6.1-6	0
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6.2A-1-7	11
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6.2A-3-5b	2
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6.2A-3-7	0
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6.2A-3-11	10
6.2A-3-12	4
6.2A-3-13	7
6.2A-3-14	7
6.2A-3-15	7
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6.2A-3-19	7
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Tbl 6.2A-3-3	10
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Tbl 6.2A-3-5	10
Tbl 6.2A-3-6	7
Tbl 6.2A-3-9	10
Tbl 6.2A-3-10	7
Tbl 6.2A-3-11	7
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6.2A-3R-2	7
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7.3-6	1
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8.2-2	12
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8.2-4	12
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Tbl 8.2-2	12
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9.2R-1	0
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9.4R-1	2
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Fig 10.3-2	0
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12-ii	0

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CHAPTER 1

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1 PURPOSE OF THE FACILITY AND ASSOCIATED TRANSMISSION

2 1.1 SYSTEM DEMAND AND RELIABILITY

In 1975, Consumers Power Company served 22.1 billion kWh to approximately 1.2
11 million electric customers in the Lower Peninsula of Michigan. By 1984, when
2 Midland Units 1 and 2 are expected to be in service, Consumers Power estimates that it will have 1.4 million electric customers on its system and that they
11 will use 30.1 billion kWh.

Consumers Power is interconnected with several utility systems within the State of Michigan as well as in neighboring states and the Province of Ontario, Canada. The operation of its system is closely coordinated with that of The Detroit Edison Company. In addition, it exchanges generation planning data with Detroit Edison. Consumers Power, Detroit Edison and other systems from several states are members of the East Central Area Reliability Agreement group (ECAR). The purpose of ECAR is to further augment the reliability of its member systems' bulk power supply through coordination of generation and
2 transmission planning and operation.

1.1.0 Consumers Power Company Energy Conservation Program

Consumers Power Company has been involved in diverse activities relating to energy conservation. These activities include both extensive work with customers as well as internal actions. The Company has been and is involved in many research activities and rate studies. Details of these activities follow.

1.1.0.1 Elimination of Sales Promotion Practices

In October 1970, the Company discontinued all efforts related to promotion of
sales of electric energy. The Company also discontinued the merchandising of
2 appliances on December 31, 1972.

1.1.0.2 Promotion of Conservation of Electric Energy

The Company has strongly encouraged builders and customers to install
substantial ceiling, wall and floor or slab insulation as well as storm
windows and storm doors in electric-heated dwellings. The Michigan Public
11 Service Commission (MPSC) has determined the Company's insulation program for
2 residential gas customers to be the most cost efficient in the State. As of
12 December 1980, over 197,000 homes have had insulation installed since the
7 inception of the program in November 1973. In Case U-5331 dated July 31,
11 1978, the MPSC established minimum insulation standards required of new
7 customers to qualify for electric space heating service. They include R-35 in
7 ceilings, R-11 in sidewalls, R-19 in floors above unheated areas, and R-11 in
7 basement walls if used as living area.

The Company presently has before the MPSC an Expanded Gas Conservation Program
that would provide interest free financing to eligible customers who wish to
install ceiling insulation. This program, when approved, is expected to
11 significantly increase the number of dwellings insulated. Adding insulation
to gas heated homes reduces the need for electric energy to operate heat
system auxiliaries such as fan motors or pumps.

2 A Thermoscan flyover program was held in Jackson, Michigan in spring 1977.
This program demonstrates the relative heat loss by building coloration on an

aerial photograph. The photo was publicized in the media and displayed at the Jackson County Fair and Company offices to acquaint Jackson residents with their relative insulation needs.

2

Company personnel work with "Community Action" agency programs on home insulation for the poor and elderly and similar energy conservation problems of these people.

12 The Company's Energy Management Services Department, which currently includes approximately 160 energy management consultants and additional General Office specialists, has assisted customers in energy conservation practices. In June 1977, a separate section was created in the General Office Energy Management
2 Services Department which has complete responsibility for energy conservation. Customer assistance has included meetings with residential customers on efficient use of appliances, in-plant visits with commercial and industrial customers, participation in a State-wide and Regional Energy Conservation
11 Expositions, and distribution of a quarterly "Energy Newsletter" to a wide
2 variety of commercial and industrial customers as well as architects and
11 engineers. In 1976, the Company began publishing a quarterly newsletter designed specifically for builders. It provides timely information on energy
2 supply, application and conservation of interest to residential homebuilders, land developers and other related businesses such as banking and lending institutions and building material suppliers.

To assist in providing customers with information on energy conservation, the
11 Company has developed and made available a wide variety of brochures including the following:

A Home Insulation Service Program

Why Insulate?

Saving Energy Is A Family Affair

The Electric Heat Pump

Selection and Use of Fireplaces and Woodburning Stoves

Solar Energy

11 Energy Use and Buyers Guide Room Air Conditioner

Energy Use and Buyers Guide Water Heaters

Energy Use and Buyers Guide Dishwasher

Energy Use and Buyers Guide Ranges

Energy Use and Buyers Guide Refrigerators & Freezers

Building Energy Efficient Homes

Saving Energy and Keeping Cool

How To Prepare Your Home For The Coming Heating Season

Since 1973 approximately 4,500,000 brochures have been distributed.

7 In November 1978, the Company implemented a $500,000 Residential Electric
12 Customer Information Program. Initially, this program included mailing
conservation information to customers along with their bills for electric
7 service. The first of four mailings scheduled for 1979 was completed in
February in which 1,150,000 copies of the booklet, "Saving Energy Is A Family
Affair," were mailed. Three additional mailings in 1979 covered air
11 conditioning, preparation for the heating season and the National Energy Watch
Program. Also, as a part of this program, the Company has appointed a solar
7 energy specialist in each of its operating regions to offer advice and
assistance to customers on all forms of solar energy.

In 1980, the direction of the program changed to include the establishment of
a Residential Energy Advisor in each electric Region. The advisors will pre-
sent energy conservation programs, answer customers' inquiries and otherwise
participate in energy conservation activities within the Regions. Plans are
being finalized for completion in 1981 of an Energy Van to be used to visually
12 convey conservation ideas and information to the public.

In August 1980, audiovisual centers were installed in 12 customer contact
areas. These centers convey conservation information to customers on a
variety of ways to conserve energy in the home.

To further promote conservation, in 1978 the Company participated in the
National Energy Watch Program which is carried out in conjunction with the
7 Edison Electric Institute. The basic concept of this program is to publicly
recognize energy efficient homes in order to encourage both builders and
owners of existing homes to bring their dwellings up to desired energy
efficiency standards. As stated, one mailing in 1979 promoted participation
11 in this program.

In 1980, the Company increased its staff to begin the planning and imple-
mentation of the Residential Conservation Service Program (RCS) which was
initially expected to be approved by September 1980. DOE approval of the
program was delayed to December 26, 1980 and the MPSC issued its imple-
12 mentation order December 30, 1980. Planning is essentially complete with
implementation now scheduled for May 1, 1981. This program provides home
energy audits, arrangement services, post-installation inspections and
conciliation services to all residential customers. The RCS Program will

promote 23 conservation measures and 10 conservation practices that residential customers can implement to reduce energy use.

In December 1980, the Company implemented a pilot energy audit program directed to low-income high-energy-user residential customers. Initially, approximately 5,000 customers were targeted to receive a special mailing offering a free home energy audit and other assistance in reducing energy use and costs. An extension of this pilot project was implemented in the City of Flint where the Company is offering to install ceiling insulation and furnace retrofits in 500 eligible customers' homes at no cost to the homeowners. This program will
12 assist the Company in evaluating the effectiveness of such measures and will also provide needed experience for later implementation of the RCS Program.

On May 28, 1981 the Company filed with the MPSC for approval of an Expanded Conservation Outreach Program. This program would be extended to eligible low-income customers throughout the Company's service area. It would also be extended to electric customers using other than natural gas from another utility for heating. It would become available to both owners and renters. It is estimated that 25,000 homes would be retrofitted under this program. MPSC approval is expected with Program tentatively scheduled for implementation July 1, 1981.

In addition, energy conservation is promoted through newspapers, radio and
2 television. A column is now offered to weekly newspapers called "Crossways" and discusses efficient use of energy and related issues.

Efforts to conserve energy in Company buildings show 29.4% savings in electric
2 energy and 29.7% in gas energy in the first year of that program following the
1973 oil embargo. This conservation program is a continuing activity.

In 1976, the Company implemented a program for the conversion of its incandescent streetlighting to more efficient light sources. The Company offers incentives to its streetlighting customers to convert incandescent
11 luminaires to the more efficient mercury vapor and high pressure sodium types.
High pressure sodium units are now a standard for new installations with mercury vapor available on request. New installations of incandescent streetlighting are no longer allowed. High pressure sodium units offer an

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energy savings of about 80 percent over incandescents. Mercury vapor luminaires cut energy use about 60 percent when compared to incandescents. Total incandescent units at the beginning of 1977 numbered nearly 45,000. As a result of the conversion program this number has been reduced by one-half. Total kWh sales for streetlighting peaked in 1977 at 166,653,000 kWh. In 1979, streetlighting sales were 160,828,000 kWh even though the total number of luminaires on the Company's system grew from 124,072 to 130,665. The Company encourages its customers to use more efficient lighting types in
11 streetlighting applications.

As part of its conservation efforts the Company tests new products to determine their potential to help conserve energy. In 1979 and 1980 the Company tested the heat pump water heater, NASA motor controller and hydrotherm pulse combustion boilers. As a result the Company recommends to its customers the replacement of electric resistance water heaters with the heat pump water heater to reduce energy requirements by up to 50%.

As stated in Section 1.1.1.2, Consumers Power has factored its energy conservation experience into its forecasts as well as further energy conservation savings which it anticipates.

2 1.1.0.3 <u>Energy Conservation Studies</u>

The Company was one of 12 utility companies in the nation that participated in a national heat pump study sponsored by Electric Power Research Institute a the Association of Edison Illuminating Companies. The Company had 10 customers with heat pumps extensively submetered to assess the costs and benefits of the heat pump as compared with alternative heating and

air-conditioning systems. Results showed the operating costs of heat pumps in
7 the Company test to be approximately 30% more efficient than comparable resistance electric heating. The national study showed better results in warmer climates, which was expected.

2 1.1.0.4 Measuring the Effect of Energy Conservation

Measurements have been made on an annual basis of samples of residential space heating customers concerning their energy conservation efforts since November 1973. Electric and gas residential space heating customers continue to
11 exhibit conservation efforts since the first few months following the Arab oil embargo, but not at the same level experienced in the winter of 1973-1974.

A special study among industrial customers, ordered by the MPSC in Case U-4576, was made to determine the potential for reduced customer usage. Many had effected some conservation prior to the survey in early 1976, all of which
2 has been reflected in the Company's Long-Range Forecast.

1.1.0.5 Conservation Efforts Through Rate Design

The Company in recent years has been ordered by the Commission to institute a flat-type rate for residential customers (November 1973) and for small
11 commercial and industrial customers (January 1975). In April 1976, the MPSC ordered inverted rates for residential customers except residential electric heat during the heating season. The effects of this rate on customer usage
2 were studied. To measure the effect of the inverted rate design, customer usage patterns were studied following both the 1975 rate increase when a flat-type rate was applied before and after the rate increase, and the 1976 rate increase when the flat-type rate was succeeded by the inverted rate. After

both rate increases, usage patterns declined slightly, but the results did not
indicate that the decrease following the imposition of the inverted rate was
any more significant than the decrease following the rate increase with no
2 change in rate design.

The inverted rate concept may influence the residential customer to reduce his
energy consumption level, but it probably will have little or no effect on
system demand on the day of the summer system peak demand. In June 1980, the
Governor signed into effect a bill which mandates the MPSC to implement a
lifeline rate within one year for residential customers. While the stated
11 purpose of this bill is to "provide for an adequate amount of electricity for
basic household needs at a lower cost" and to "provide an economic incentive
to conserve energy resources," it remains to be seen whether these objectives
will be met.

2 Time-of-day rates have been offered for years to large commercial and
industrial customers by disregarding off-peak demands in the determination of
11 the on-peak billing demand. Of the approximately 1,600 customers eligible for
this rate, only 11 customers have consciously shifted some load to off-peak
periods, accounting for a reduction of some 100,000 kW in demand, which is
already reflected in system demand. Based on a survey conducted by Consumers
Power in early 1976 (and discussed in Section 1.1.0.4) of its large primary
2 commercial and industrial customers, many of them indicated that there was
little likelihood that they would shift load from peak load periods. With the
cost of electric energy generally being less than 5% of their total product or
operating cost, there is little incentive to make the changes necessary to
shift load.

Consumers Power Company's annual load factor is among the highest of utility companies in the country. In addition, the Ludington Pumped Storage Plant
2 provides a further improvement to the Company's load profile so that the benefits of shifting load from on-peak to off-peak may be substantially less for Consumers Power Company compared with other, more typical utility companies without pumped storage facilities.

11 In April 1976, the MPSC ordered time-of-day energy pricing for the energy purchases of the primary commercial and industrial customers. The Company attempted to determine the impact of this rate on the affected customers. While modest improvements occurred in load factor and percent on-peak consumption, there were so many other factors impinging on customers affected
2 by this rate that ascribing this improvement to the introduction of time-of-day rates is of doubtful validity. In comparing the periods before and after implementation of time-of-day rates, it should be noted that the on-peak period covers a different number of hours and some differences in time periods during the day. In addition, economic conditions improved from one period to the next and the energy cost differential amounted to only 0.2 cent/kWh.
In August 1980, the Commission established a three-part energy charge: on-peak, intermediate-peak and off-peak. The differential between the on-peak
12 and off-peak is 0.7¢/kWh and the differential between the on-peak and intermediate-peak is 0.4¢/kWh.

11 In April 1977, the MPSC approved an extensive experimental program for
2 measuring residential and small commercial and industrial customers' responses
12 to time-of-day pricing proposed by the Company. This program involved
2 approximately 210 residential customers and 265 small commercial and

12 industrial customers and covered a 24-month period. During this time the test customers were actually be billed on the special time-of-day rates. The test included a subsample of large use farm customers and the installation and 11 testing of electric storage heat concepts in eight residential dwellings. At the conclusion of these studies the sample customers' usage patterns were compared with those of a control group billed on the standard rates. This has provided some insight into how sensitive customers are to altering their 2 current pattern of electric usage for the purpose of saving on their utility 12 bill. This test program and the controlled load experiment discussed below cost some $1,200,000 to complete. The Company will be submitting evidence and testimony concerning the cost effectiveness of time-of-day rates for 11 residential and small commercial customers in the next filed rate case as mandated in the MPSC Order in Case U-6490 issued May 2, 1980.

12 Incorporated in the above program was a controlled load experiment. This 2 involves an on-line experiment for controlling customer loads during peaks of system electric demand. The experiment, conducted in the Jackson area, demonstrated that water heating loads can be controlled for up to four hours without customer dissatisfaction. The payback load is approximately twice the load reduction. Average diversified water heating loads range from 0.5 to 0.75 kW during peak hours. The use of 15 minute per hour controls for central 11 air conditioning and space heating did not result in significant load reductions due to the cyclic nature of these loads. However, modest reductions in large commercial air-conditioning loads can be achieved when outdoor temperatures exceed 76 degrees. The Company will be submitting evidence and testimony concerning the cost effectiveness of interruptible air conditioning and water heating rates for residential and small commercial

customers in the next filed rate case as mandated in MPSC Order in Case U-6490
11 issued May 2, 1980.

The MPSC ordered the Company and Detroit Edison as follows (Cases U-4576 and U-4570, respectively):

> Residential loads shall be analyzed with respect to price elasticity on average for applicants' service area. The analysis shall consider breakdowns for loads of less than 500 kWh per month, for loads of 500 to 1,000 kWh per month, and for loads in excess of 1,000 kWh per month. In
> 2 addition, interstate comparisons of residential loads at different price levels shall be submitted.

The two companies hired Economic Analysts, a division of Equitable Environmental Health, Inc from Park Ridge, Illinois as consultants.

There have been many studies in the past 15 to 20 years to determine the numerical magnitude of the elasticity coefficients. These studies have
12 resulted in a variety or short-run and long-run elasticities. There are numerous problems in applying the results of these studies to current conditions and to the Consumers Power system. The primary problems are: first, it is questionable to use aggregate data covering many utility areas, rather than specific systems; second, that the data included and the resulting elasticities were measured during periods of declining energy prices and thus
2 indicated the amount of increase in energy consumption per decrease in price, there being inadequate evidence to establish that once the customer's usage pattern has been set at a higher level, he would decrease consumption due to higher energy prices at the same rate at which consumption was increased; third, that elasticities have not been developed for customers at difrering levels of electricity consumption; and finally, questions of how to measure the price variable.

The findings of the consultant, while developing short-run price coefficients which were in close agreement for the two companies and in the general range of values found in other studies, could not show that these price coefficients were true measures of price elasticity. Because of the declining block rate structure and little variation in price during the period under study, the consultants could not establish a measure of price elasticity.

2 Marginal Cost Pricing attempts to provide the customer with information regarding his cost of the next unit of energy purchased. The customer cost would reflect the utility's cost of adding a new generating facility or purchasing high-cost power. One of the many problems is that utilities are governed by historical revenue constraints and once marginal cost rates are scaled back to fit this constraint, the resulting rate really is not priced at
11 marginal costs. The MPSC, in Order U-4840, stated that this method of pricing "...in a practical sense can accomplish little more in the way of providing correct price signals to the consumer than the current revenue requirement method."

Those advocates of marginal cost pricing anticipate that energy users faced with the higher marginal costs may reduce their energy consumption. However, on summer system peak demand days, which generally occur on the hottest
2 weekday of the summer, customers are likely to run their air-conditioners and other cooling loads with little regard for the price. The Company will in all probability experience what are commonly referred to as "needle peaks" that would be essentially of the same magnitude as peaks created under conventional embedded cost ratemaking philosophy.

In December 1974, the National Association of Regulatory Utility Commissioners (NARUC) at its annual convention passed Resolution 9 which called for the Edison Electric Institute (EEI) and the Electric Power Research Institute (EPRI) to conduct a joint study "of the technology and cost of time-of-day metering and electronic methods of controlling peak-period usage of electricity and also a study of the feasibility and cost of shifting various
2 types of usage from peak to off-peak periods."

The first phase of this project was funded by EPRI at approximately $1,000,000 and was directed by the Project Committee through a full-time executive director. The study representation came from investor-owned utilities, American Public Power Association, National Rural Electric Cooperative Association, National Association of Regulatory Utility Commissioners and others.

11

All of the task force findings have been published and a summary report was issued in early November 1977. There were four recommendations for the future as follows, with certain members of the Project Committee exhibiting disagreement in general and specific disagreement with Item d:

2 (a) Additional research is needed.

(b) Regulators and utility managers should evaluate the cost-effectiveness of time-differentiated rates and load controls.

(c) When an evaluation shows that benefits exceed costs, load management strategies normally should be implemented gradually.

(d) Rates should reflect marginal costs to the extent possible.

2 Most of the Project Committee rejected Item d on the basis that the research in the report did not support the recommendation.

A second phase of the study calling for a more in-depth study of certain phases of the issues has been completed and while no additional conclusions have been drawn, many of the issues being studied were mandated by the National Energy Act and more specifically PURPA (Public Utility Regulatory Policies Act). This legislation, passed in November 1978, covered every electric utility with retail sales in excess of 500 million kWh annually. It stipulated that each utility should study and/or implement certain ratemaking standards. These were:

(a) Cost of service based rates

(b) Prohibition of declining block rates except wehre cost justified

11 (c) Implement time-of-day rates where cost justified

(d) Implement seasonal rates where cost justified

(e) Implement interruptible rate

(f) Implement load management where cost effective

(g) Implement a lifeline rate unless determined through an evidentiary hearing that it should not be.

In addition to the above ratemaking standards each utility must meet certain standards related to master metering, automatic adjustment clauses, customer

information termination of service and advertising. While Michigan and
11 Consumers Power Company are already essentially in compliance with each of
these standards it will remain to be seen what transpires as a result of the
state ordered generic hearings dealing with each of these standards.

Customer reaction to changes in design of rates as well as changes in levels
of rates is an extremely complex subject and cannot be simplistically
2 resolved. Given a residential customer's mix of appliances, it is difficult
to change his patterns of use unless he perceives significant benefits. An
annual study at Consumers Power shows the average residential nonelectric
11 heating customer is currently using only 1.42 percent of his effective buying
7 income for his annual electricity purchases. This ratio has varied since 1961
11 from a low of 1.14 percent in 1968 and 1972 to a high of 1.55 percent in 1961.
2 This means that electricity is not a major cost item in his budget nor has it
increased significantly in relationship to his effective buying income over
the past 18 years.

11

The Company's study of time-of-day rates, which has just been completed,
should show the customer's propensity to voluntarily defer use of a portion of
his electric consumption to an off-peak period. However, there are many who
view with scepticism the ability of a customer to voluntarily defer loads such
2 as air conditioning, cooking, television, lighting and water heating. That
customer may defer some loads or may reduce his level of use but either of
these actions may have little or no effect on his use of electricity at the
time of the utility system peak demand.

1.1.0.6 Implications of Energy Conservation for Consumers Power Load Forecast

Consumers Power has been involved in many projects, which are discussed above,
to encourage energy conservation among its customers. Beginning in 1973,
2 there has been evidence that customers are responding to such programs. The
effect of those efforts has been incorporated in the Company's current long-
range forecast. Additional rate design incentives to conserve energy and
reduce peak loads have also been instituted during this period, including the
11 flat-rate concept for small commercial and industrial customers, time-of-day
pricing for residential space heating, large farms and large commercial and
2 industrial customers and, more recently, an inverted rate structure for
residential customers. Significant increases in overall rate levels have also
11 occurred during this period. Such stimuli have modified the increase in
consumption levels which has been reflected in the Company's forecasts.

Only through radical increases in rate levels, along with the application of
radically new rate structures which dramatically change historical price/usage
relationships, are further significant changes in usage patterns likely to
occur. The Michigan Public Service Commission is unlikely to permit radical
price increases and its concern with the effect that radical changes in rate
2 structures may have on the economy of the State, particularly its concern that
industry could be driven out of Michigan, will in all likelihood cause it to
take a cautious and moderate approach toward such changes. Consequently,
Consumers Power believes that consumption patterns are very unlikely to
deviate substantially from those currently projected and reflected in its
forecasts for the period through the early 1980s.

1.1.1 Load Characteristics

1.1.1.1 Load Analysis

2 Historical peak load data and forecasted peak loads are listed in Table 1.1-1 for the years 1966 through 1995. Data are shown for Consumers Power alone, combined with Detroit Edison and for ECAR. Table 1.1-2 lists historical and projected energy requirements for the same period.

11

Figure 1.1-1 shows Consumers Power's load duration curve for the year 1978.
2 Current peak demand and energy forecasts support the extension of this data to
11 1983 and 1984 conditions without significant modification.

1.1.1.2 Demand Projections

The projections of peak demand and energy requirements appearing in Tables 1.1-1 and 1.1-2 are based upon forecasted energy sales to customers. Table 1.1-3 lists historical and projected sales to ultimate customers for the period 1966 through 1995.

1.1.1.2.1 Consumers Power Company Forecasting Policy and Procedures

General

The official forecasts of both future energy sales and peak demand for Consumers Power Company are approved and issued by the Energy Forecast Executive Review Committee (EFERC). The membership of the committee consists
12 of the Company CEO as committee chairman and several other Company officers as committee members. The approved forecasts which are used in budget

preparation and other planning activities are updated annually and on interim bases as required. The data are documented and distributed by means of a forecast data book and recorded in the minutes of the EFERC meetings. Any Company document or study utilizing future projections of energy sales or demand should reference the forecast currently in effect or should explicitly state that the official forecast was not utilized and what assumptions were.

12 The Company's current sales projections were developed in two separate departments using different though similar methodologies. Each is developed by major class of service and is in part the result of applying regression equations to forecasted economic and other factors which have been important in explaining historical levels of customer consumption. Some differences, however, do exist in methodology and the resulting projections due to a
11 difference in purpose. Since the short-range forecast is to be used as a basis for the Company's planning of specific years, it reflects the most accurate monthly forecast available for these years. The long-range forecast consists of annual projections which are to be used as a strategic planning tool and as such reflects the most likely levels of consumption over a period of several years as a whole.

12 1.1.1.2.1.1 <u>Short-Range Forecast</u>

11 Briefly, the short-range projections are developed through the use of a recursive multi-equation model which incorporates a forecast of economic
12 activity, as well as other variables such as price per kWh to the customer and weather indicators, with results from direct customer contacts. Normally this
11 forecast is approved in August of each year extending out 29 months to the end of the planning year.

Projections shown on Table 1.1-3 reflect the current short-range forecast for the current and following years and the long range thereafter.

11

Since this report is most concerned with years beyond which the short-range forecast has been developed, the remaining discussion in this section focuses on the long-range methodology.

12 1.1.1.2.1.2 Long-Term Sales Forecast

The long-term forecast currently extends 15 years into the future on an official basis for the projections of electric and gas energy sales and electric peak demand. This forecast is extended further on an unofficial basis in order to support certain very long-range planning activities.

The long-term forecast is constructed by identifying the factors which determine the major trends in average, annual growth rate. These trends may be expressed over intervals of 5, 10, or 15 years depending on the assessment of major variations in future conditions. By employing a general trending approach, the long-term forecast does not include yearly fluctuations due to business cycle effects. In addition, since the time increment of the long-term forecast is years, no seasonal weather variations are included. The long-term forecast takes as its point of departure the Company's current send-out and demand data at the time the forecast is prepared and, therefore, there will be some overlap with the short-term forecast. Since each forecast has its own specific uses and techniques, the separate results for the overlap period are not expected to be identical. However, the comparison of this common data can be used as a rough, independent cross-check of consistency between the two forecast methodologies.

12 Preparation of the long-term forecast is the responsibility of the Corporate
Planning Department which obtains inputs and specific analyses from various
sources within and outside the Company as required. For example, projections
11 of future system load factors are supplied by the Energy Control Department
and general economic forecasts are provided by the Economic and Financial
Planning Department. The long-term forecast is reviewed by the EFERC in
2 January in order to provide a current long-term forecast for the initiation of
the Company's yearly long-term planning update.

7 The EFERC has reviewed and approved a revised long-term forecast of electric
energy sales and peak demand as of October 1980. This update supersedes the
previous long-term forecast approved by the EFERC in December of 1979. The
12 new forecast projects a 1979-1995 average annual compound rate of growth (AAR)
of 2.8%.

Peak demand for the years 1980 through 1995 was calculated assuming a load
11 factor of 68.5% and a system efficiency of 91.5%.

2 A range of uncertainties was developed for the new forecast. Expressed as a
11 percentage of the 1979 sales, the high range (having a 15% probability of
occurrence) shows a 115% increase by 1995, while the low range (also having a
15% probability of occurrence) exhibits no growth from current levels over the
12 same period. The expected value for 1995, which has a 70% probability of
occurrence, was projected to increase by 56% from the 1979 level.

7 The forecast represents a downward revision from historic growth rates. It
was prepared by combining regression analysis of the past sales data with

specific investigations of certain "forward looking" items which were identified as likely to influence future sales. The future state of the
2 economy was the most important determinant of future energy sales, but considerable impact was exerted by the projected price of energy and the
7 multiple factors predicted to be the outcome of the National Energy Policy.

7

Interim Analyses

Because of the year-long interval between revisions of the Company's forecasts, events will occur in the interim which have a potential impact on the forecast. Necessarily, various departments within the Company will undertake analyses of these events. These analyses are not published as new forecasts but only as situations which could potentially change the Company's
2 forecasts. All such information is available to the members of the EFERC and to the departments having the responsibility for preparing the forecasts. If in the opinion of the EFERC or other members of the Company's top management the new developments are of a sufficient significance, a new forecast may be undertaken immediately. If not, the information from these interim analyses is retained for inclusion in the next annual forecast update.

12 1.1.1.2.2 Sales Forecast Methodology

11 The current sales forecast was developed utilizing a methodology which combines regression analysis with specific investigations of factors which could influence future sales but are not present in the past data. The
2 independent variables in the regression analysis were, in large measure, economic variables which were projected by the use of a separate economic

forecast. The forecast was also characterized by preparing a separate
forecast for each sales category and, where appropriate, breaking down certain
of the more important categories into more detail. Where possible, data from
direct customer contact was employed. An uncertainty range for the forecast
2 was built up by developing the uncertainties associated with the individual
forecast components. This was done by means of encoding techniques which were
used to develop subjective probabilities from the various contributors to the
forecast.

12 The starting point of the October 1980 forecast was a detailed regression
analysis which attempts to capture the significant causal factors from the
past 10-15 years of electric sales data. Many possible independent variables
2 and model forms were tested until the final models, as presented in Table
1.1-4, were selected based on statistical evaluation and inspection for
7 logical consistency. The independent variables in the various models are
generally comprised of economic parameters and the price of energy. The
projections of the economic parameters were obtained from a national economic
2 forecast which was, in large part, based on the econometric models utilized by
Data Resources Incorporated (DRI), one of the major national economic
consulting firms. The use of national economic projections instead of local
11 data was selected for three reasons. First, the Michigan economy, which
includes the economy of Consumers Power Company's service area, is highly
influenced by the automotive industry and has historically followed national
2 trends. Secondly, there is currently no long-term "bottom up" projection of
the Michigan economy available. There are some generalized regional models
based on adjusted national trends, but this is essentially what the regression
11 analysis achieves. Third, the quality of historic national economic data is

11 much better than the quality and consistency of local economic data. The
2 projections for the cost of electricity and gas for use in the regression
models were developed from the 15-year corporate planning analysis prepared in
11 1979 using the Consumers Power Company planning model.

The impact of future factors or "forward-looking" items was developed from
individual analyses which were directly applied as adjustments to the
regression model results. Because of the overlapping of many of the factors
relating to the general categories of conservation and the National Energy
2 Policy, care was taken to avoid, to the extent possible, double counting of
the same effect. Specific investigations or factors were developed for
appliance efficiency improvements, cogeneration, industrial and commercial
conservation and conversions to alternate fuels, electric vehicles and solar
energy utilization.

Where possible, the forecast employed data directly obtained from various
12 customer samples. Included in this category was a major study conducted by
11 the SRI International (SRI) in 1977 of the energy end use of the Company's
major industrial and commercial customers. This study resulted in an
assessment by SRI of the potential in these two sales sectors for additional
2 conservation and conversion to and from alternate energy sources. The major
new finding from the SRI study in relation to electric sales is that there is
only a modest potential in the next 10 years for switching from gas or other
fossil fuels into electricity. An in-house update of this SRI study was
11 conducted in 1979 and is also used in the forecast. In addition, there were
2 several direct interviews by Consumers Power Company personnel with our
customers or other Michigan sources in regard to various aspects of the

2 forecast. These included discussions with Dow on their electricity usage
projections, General Motors on their economic and sales forecasts and views on
11 electric vehicles, DRI on their economic forecast, various sources (GM, Ford,
2 EPRI and DOE) on the general status of electric vehicles, a major heating
11 equipment distributor on market projections for the heat pump, and several
industrial customers on their cogeneration potential.

The range of uncertainty developed as part of the forecast utilized the
technique of probability encoding. In this method the information source or
knowledgeable person is interviewed about possible swings in the future value
2 of the variable under study. The result of the interview is a cumulative
probability distribution for that variable. With similar information for the
major forecast inputs, the data can be statistically combined and a
probability range established for the dependent variable, ie, the sales
forecast.

11

The results are discussed in the following sections:

2 Residential Sales

The forecast of residential sales is divided into two parts: Residential
space heating sales and residential domestic sales. A regression model was
used to forecast residential customers. Residential space heating average
12 usage per customer and residential domestic average usage per customer were
projected through end-use analysis.

11 A relatively significant downward adjustment in average usage results from the
7 projection of improvements in appliance efficiency. Based on the National
2 Energy Act, mandatory appliance efficiency standards will be implemented and
11 are assumed to be in effect starting in the mid-1980s. Calculations were made
based on predictions of what the improvements in efficiency would be,
2 projected appliance saturations, and a calculation of the percentage
penetration each year into the general appliance population by the new, more
efficient appliances.

12

4

12

11

The expected value for the growth in residential sales for the 1979-1995 time
12 frame is 2.8% per year in the current forecast. This is a considerable
reduction from pre-embargo trends in this sales sector and reflects the
7 downward pressure from increasing energy costs, improvements in appliance
2 efficiency, general conservation in domestic usage, improvements in space-
11 heating efficiency due to the heat pump, and the impacts of solar energy and
the electric vehicle.

7

Commercial Sales

The approach used to project commercial sales was to establish a base forecast
2 using a regression model (refer to Table 1.1-4) and to apply analyses of the
potential impact of specific "forward-looking" items to this base forecast.

12

The regression models, economic forecast and the Company's projections of
2 future electric and gas prices result in a growth rate in commercial sales of
12 3.5%/year between 1979-1995.

11

Industrial Sales

2 The approach used to project future industrial sales was to develop a
regression model base forecast (refer to Table 1.1-4) and then to modify the
2 base forecast for specific forward-looking items. Separate regression models
7 were developed for both GM sales and for industrial sales to other than Dow
2 and GM. Sales to Dow were forecast by direct consultation with Dow.

The expected value of 1995 sales forecast for industrial sales, combining the
12 regression model results with forward-looking items, translates to a 2.5% AAR
for the 1979-1995 time frame.

2 Other Sales

12 Streetlighting - The October 1980 forecast of streetlighting sales was
2 developed based on the current program to convert the existing incandescent
7 and fluorescent luminaires to high-pressure sodium. This results in declining
12 annual sales, even though the total system luminaires are assumed to increase.

7

12 Sales to Other Utilities - Sales to other utilities are projected to grow at
11 about the same rate as Consumers Power Company sales through 1982. Beyond
2 1982, an AAR of about 75% of the Consumers Power rate is assumed to reflect
2 the possible construction of generating facilities by groups of our wholesale
7 customers.

2 Interdepartmental - Interdepartmental sales are assumed to hold constant at
12 about 70 million kWh level for all years after 1982.

1.1.1.2.3 Generation Requirements and Peak Load Projections

Consumers Power's peak load projections are developed from its sales forecasts. Since the sales forecasts measure energy requirements at the point of sale and energy losses take place between the generation facilities and the
2 point of sale, the sales forecasts must be divided by an efficiency factor to determine the amount of generation necessary to meet the sales forecasts. The efficiency factor is a ratio of sales to generation calculated on the basis of historical trends, modified to reflect known or expected factors that will influence efficiency. Application of the efficiency factor results in an

estimate of the total generation requirement in kWh necessary to meet the annual sales forecast. The expected peak load is calculated by dividing the average demand (ie, the total generation requirement divided by the hours in the year) by the estimated annual load factor for the year. The annual load factor is a ratio of average demand to peak demand.

2 Annual load factors are developed from historical relationships of load factors based on summer maximum demands and winter maximum demands. In projecting future load factors, consideration is given to the impact of such things as energy conservation, pricing of energy, availability of gas with the resultant effect on the use of electricity for heating, load management and general economic conditions. Since some of these factors tend to improve load factor and others tend to decrease load factor, the load factor for future
11 years has been projected at a constant 68.5%, realizing that in any given year the actual load factor can deviate from the projected load factor in either
2 direction.

Monthly Peak Loads

11 Table 1.1-5 lists Consumers Power's actual monthly peak load data through the most recent month for which data are available. Table 1.1-6 lists forecast monthly peak loads for the same period and the percentage deviation of the
2 forecasted load from actual. Tables 1.1-7 and 1.1-8 list similar data on monthly energy sales for the same period.

Response to FPC Order 496

Consumers Power's response to FPC Order 496 is included as Exhibit B to the Environmental Report Supplement.

2 1.1.1.3 Power Exchanges

Consumers Power does not include power exchanges with other utilities as a part of its load. Such exchanges are reflected in the capacity availability figures and are treated under Section 1.1.2.

1.1.2 System Capacity

Table 1.1-9 summarizes Consumers Power's projected installed capability over
11 annual peak load for 1971 through 1986. Also shown are the most recently available data for the combined Consumers Power-Detroit Edison system and for
2 ECAR. Not included in the tables, but an important factor in capability assessment, are estimated deratings to the capabilities shown due to higher cooling medium temperatures in summer. These are listed below for 1983 and
11 1984 when the Midland units are projected to be placed in service.

		Derating - MW	
		1983	1984
2, 11			
12	Consumers Power	245	286
	Consumers Power-Detroit Edison	401	442
2	ECAR	1852	1943

Also shown in Table 1.1-9 are actual and projected capacity sales at time of peak. Shown separately is the lease of capacity to the Commonwealth Edison

Company from the Ludington Pumped Storage Plant, which is jointly owned by
2 Consumers Power and Detroit Edison. Included in the installed capability
listed is the anticipated net ownership from Consumers Power's Campbell Unit 3
11 and from Detroit Edison's Enrico Fermi Unit 2. Purchase of portions of these
units is anticipated by rural electric cooperatives and municipal systems
within the State of Michigan. Capacity from these units not immediately
2 needed by the purchasing systems is expected to be sold back as unit power and
is also shown. The details of the expected transactions and purchases are:

	Capacity Sold - % of Plant					
	1981	1982	1983	1984	1985	1986
Cooperatives:						
Campbell 3	1.89	1.89	1.89	1.89	1.89	1.89
Campbell 3 Sell Back to CP	1.51	1.32	1.13	.95	.76	.57
E Fermi 2	0	0	20.00	20.00	20.00	20.00
E Fermi Sell Back to DE	0	0	14.46	12.63	10.89	9.06
Municipals:						
Campbell 3	4.80	4.80	4.80	4.80	4.80	4.80
Campbell Sell Back to CP	2.92	2.70	2.35	1.77	2.81	2.72

Table 1.1-10 lists the composition of Consumers Power's generating system for
2 the initial year reported in Table 1.1-9 (1971). Table 1.1-11 lists changes
in capability, unit additions, and long-term transactions in chronological
11 order through 1986. Data are given for both Consumers Power and Detroit
2 Edison.

11 The composition of Consumers Power's generating system for 1984, including the
2 expected range of unit capacity factors, is shown in Table 1.1-12.

1.1.3 Reserve Margins

Consumers Power determines installed generating capacity requirements and
2 reserve margins based on a generation planning reliability design guide which
recognizes that Consumers Power, being a part of the integrated regional
system, will as a minimum plan to install equitable generating capacity such
12 that an average loss of load expectation (LOLE) index of 1 day/10 years is
2 maintained. Included in these assessments are consideration of peak load
levels throughout the year, generating unit maintenance, load forecast
12 uncertainty, reductions in unit capacity due to hot weather, statistical
treatment of random unit outages, and mutual assistance within the integrated
regional system.

1.1.3.1 Maintenance

For probability assessment purposes, generating unit maintenance is assumed
scheduled so as to levelize the risk of outage over the entire year. To do
2 this, scheduled maintenance on units is preferentially grouped to the extent
possible, in periods of the year when the level of loads is lower (ie, autumn
and spring).

1.1.3.2 Loss of Load Probability Methods

Application of the generation planning reliability design guide requires that
a loss of load probability (LOLP) method be applied to an integrated regional
11 system of companies. The actual determination of the LOLE index for the
integrated system is completed with the use of computer simulations. For the
2 purposes of this computation, the year is modeled by monthly intervals.
Within each month maintenance is considered constant. Based on projected

2 generating unit maintenance requirements and peak loads for each month, a
schedule of unit outages is developed. Then, for each month, a normal
11 capacity outage distribution is determined using standard techniques. The
projected weekday peak loads are convolved with the normal capacity outage
12 distribution to yield a capacity surplus or deficiency and its corresponding
probability of occurrence.

This simulation is first performed for a system with a peak load equal to the eastern United Stated and Ontario Hydro (called the integrated regional system) but with a load shape and generating unit characteristics and mix which is equivalent to the combined systems of the East Central Area Reliability system and Ontario Hydro. Generation capacity is then adjusted until a 1 day/10 years LOLE is obtained. This simulation indicates the aggregate generation capacity requirements of the utilities in the eastern United States and Ontario Hydro. An additional simulation is then performed in order to allocate the capacity requirement to each utility. The philosophy
11 is that each utility must supply an equitable capacity contribution to the
integrated regional system (IRS). Given any reliability goal for the IRS, Consumers Power Company should, therefore, receive support (measured by negative days) from the IRS members equal to the support received by an Average Integrated Regional System (AIRS). The AIRS for Consumers may be defined as one whose peak demand is equal to Consumers' peak demand and whose load shape and generating units characteristics and mix is equivalent to the IRS. Consumers Power Company required generating capacity is then determined by adjusting Consumers Power's reserve to maintain the negative day count of an AIRS to support the established 1 day/10 years LOLE index.

2 Consumers Power's generating unit capacities for purposes of reliability
11 studies are as shown in Table 1.1-9. Unit availability and maintenance
2 projections for the first year of service of Midland units are shown in Table 1.1-13. The monthly load model for Consumers Power for the same year is shown in Table 1.1-14. The systems in ECAR are modeled from information taken from reports entitled "Regional Reliability Council Coordinated Bulk Power Supply Program" ERA-411, April 1, 1980 and "Appraisal of ECAR-WIDE Installed Reserves for the Period 1979-1988", 79-GRP-57. Ontario Hydro's unit information was obtained from a report by the Resources Planning Department, System Planning
11 Division of OH entitled "January 1980 Forecast of Reliability Indices For Use in Corporate Planning Studies".

Results of the analysis for a AIRS load of 5150 MW appear in Figure 1.1-2. This figure presents the relationship between the required negative days for an AIRS and the supported LOLE index for the IRS. As can be seen, for an LOLE index of 1 day/10 years Consumers Power would be required to install capacity so that external support would be requested for no more than 46 days/year. Figure 1.1-3 translates this negative day requirement into a capacity requirement at 23% unit unavailability. The graph indicates that Consumers Power would require a reserve level of 25.5% to equitably support an LOLE index of 1 day/10 years.

12

The above development is an evaluation of Consumers Power's capacity contribution in supporting the integrated regional system for one year. Consumers Power's reliability design guide averages these yearly supportive loss of load expectations over the study period. An average 1 day/10 years LOLE has been set by Consumers Power as the minimum installed capacity level

to maintain. This level translates to approximately a 23% reserve level over summer peak load for Consumers Power under present system characteristics.

Consumers Power has developed its reliability criterion further by addressing the issue of load forecast uncertainty. Consumers Power Report PRP-80-2 entitled "Reliability Methods Appraisal" develops the reliability measure
12 called "expected supportive LOLE". This measure explicitly accounts for load forecast uncertainty by evaluating reliability at three load levels each representing a point on Consumers Power's load forecast uncertainty distribution. Studies indicate that a 36 day/year expected supportive LOLE is equivalent to Consumers Power's reliability design guide of an average of 1 day/10 years LOLE on the integrated regional system.

1.1.3.3 Capacity Support

Whenever capacity is added to a system, the amount of reserves in megawatts
2 needed to cover outages increases. In terms of percent of peak load, however, the generation reserves required remain nearly constant. This is due to the fact that the capacity is not added until load has increased to the point
11 where it is needed. The impact of the addition of a generating unit or units to a system is always to enhance its reliability.

2 With respect to its interconnections, Consumers Power's policy is to provide sufficient transmission capability so that, under credible contingencies, the full amount of capacity support needed from outside sources can be imported.

1.1.3.4 Reserve Responsibility

ECAR has established the following objectives:

(a) Assure an abundant supply of electric energy to meet present and future needs.

(b) Achieve maximum reliability and continuity of service.

2 (c) Accomplish the first two objectives while protecting and preserving the environment.

Under the terms of Consumers Power's coordination agreement with Detroit Edison, Consumers Power is not obligated to maintain a particular reserve level; instead it has agreed to provide an adequate amount of reserve to meet operating reserves. It is Consumers Power's judgment that its reliability assessment methodology adequately meets both of these requirements.

1.1.4 External Supporting Studies

As stated in Section 1.1.3.4, Consumers Power's coordination agreement with Detroit Edison does not obligate either party to maintain a particular reserve level. Therefore, the information requested in Section 1.1.4 is not available on a power pool basis. However, both Consumers Power Company and The Detroit Edison Company are members of the East Central Area Reliability Council
12 (ECAR). ECAR's Generation Reserve Panel (GRP) does appraise the ECAR system on a regular basis.

Based on an "Appraisal of ECAR-Wide Installed Reserves for the Period 1980-1989", Interim Report No 80-3, for the years 1983 and 1984, at the

current level of generating unit unavailability of 30 percent, the ECAR system of companies will operate at an LOLE index of approximately 41 days/year. It should be noted that this study assumed all units presently scheduled for operation by 1983 and 1984 to be in service. Delays in the in-service dates of these units would adversely change the LOLE index.

ECAR's GRP is evaluating a reliability criterion for the combined ECAR system. However, an official criterion has not been approved. Historically, ECAR has
12 experienced an average dependence on supplemental capacity reserves of 4 days/year (LOLE).

Based on the report entitled "Appraisal of ECAR-Wide Installed Reserves for the Period 1980-1989", Report No 80-GRP-57, an ECAR reserve level for a particular reliability level may be determined based on an isolated ECAR system at varying generating unit unavailabilities. In order to maintain the historical LOLE for ECAR (4 days/year) with the recent ECAR generating unit unavailability of 30 percent, ECAR would require a summer reserve level of 40 percent.

TABLE 1.1-1
SUMMER AND WINTER PEAK DEMANDS 1966-1995
(MW)

		Consumers Power		Combined Consumers Power - Detroit Edison		ECAR (Bulk)	
12	Year	Summer	Winter	Summer	Winter	Summer	Winter
2	1966	2,522	2,860	6,530	7,099	-	-
	1967	2,673	2,941	7,080	7,280	-	-
	1968	2,979	3,180	7,808	7,833	36,877	36,308
	1969	3,184	3,377	8,320	8,435	38,586	39,362
	1970	3,343	3,458	8,751	8,494	40,676	41,388
	1971	3,604	3,711	9,573	9,010	44,251	42,544
	1972	3,808	4,080	9,743	9,709	47,155	45,947
	1973	4,394	4,105	11,265	9,630	52,512	46,455
	1974	4,109	4,033	10,709	9,417	50,362	47,462
	1975	4,134	4,194	10,454	10,019	50,840	51,428
	1976	4,185	4,282	10,798	10,207	53,703	54,461
	1977	4,542	4,281	11,923	10,339	59,476	57,986
	1978	4,588	4,436	11,756	10,657	59,038	59,980
	1979	4,479	4,343	11,224	10,027	59,008	59,835
	1980	4,540	4,310	11,243	9,888	60,638	62,609
12	1981	4,400	4,300	11,272	10,337	63,878	66,464
	1982	4,490	4,380	11,835	10,709	68,025	69,151
	1983	4,950	4,770	12,691	11,331	70,739	71,885
	1984	5,200	4,990	13,237	11,725	73,162	74,724
	1985	5,440	5,210	13,730	12,108	75,789	77,593
	1986	5,580	5,330	14,141	12,404	78,526	80,472
	1987	5,740	5,480	14,547	12,721	81,159	83,263
	1988	5,910	5,620	15,015	13,047	83,880	86,506
	1989	6,080	5,770	15,398	13,331	86,662	89,606
	1990	6,250	5,930	15,806	13,647	NA	93,100
	1991	6,390	6,050	16,172	13,910	NA	96,300
	1992	6,600	6,240	16,591	14,236	NA	100,000
	1993	6,840	6,450	17,046	14,588	NA	103,400
	1994	7,060	6,640	17,480	14,917	NA	106,900
	1995	7,290	6,850	17,923	15,267	NA	110,400

Notes: Data prior to Winter 1980 are actual for Consumers Power and Detroit Edison.

2 ECAR was organized in January 1967.

ECAR data 1968-1976 based on appendix to report entitled "Load and Capacity Appraisal," ECAR 80-GRP-33 and 33A.

12 ECAR data 1977-1995 are based on report entitled "Regional Reliability Council Coordinated Bulk Power Supply Program", ERA-411, Volume II, for years 1978-1980.

4

NA = Not Available.

TABLE 1.1-2
ENERGY REQUIREMENTS 1966-1995
(GWh)

	Year	Consumers Power	Combined Consumers Power - Detroit Edison	ECAR (Bulk)
12				
	1966	15,891	40,595	NA
	1967	16,665	42,276	205,679
	1968	18,111	46,286	223,567
	1969	19,435	49,738	240,049
	1970	20,095	51,253	250,863
2	1971	21,509	54,571	263,715
	1972	23,330	58,946	285,368
	1973	25,212	63,04[illegible]	308,819
	1974	24,626	60,620	305,601
	1975	24,282	59,316	308,153
	1976	25,995	64,041	331,800
	1977	26,830	66,066	347,211
	1978	27,493	67,423	350,477
	1979	27,906	67,499	359,710
	1980	26,897	64,028	363,600
	1981	26,384	65,040	384,700
	1982	26,949	67,886	404,900
	1983	29,680	72,525	420,900
	1984	31,180	75,455	436,800
	1985	32,640	78,134	453,300
12				
	1986	33,480	80,284	469,500
	1987	33,450	81,440	485,700
	1988	35,450	84,878	503,300
	1989	36,460	86,917	520,100
	1990	37,530	89,133	NA
	1991	38,360	91,054	NA
	1992	39,630	93,333	NA
	1993	41,020	95,760	NA
	1994	42,340	98,114	NA
	1995	43,750	100,548	NA

11 Notes: Data prior to Winter 1980 are actual for Consumers Power and Detroit Edison.

12 ECAR data 1977-1995 are based on report entitled "Regional Reliability Council Coordinated Bulk Power Supply Program", ERA-411, Volume [illegible], for years 1978-1980.

4

2 NA = Not Available.

TABLE 1.1-3

MAIN SYSTEM ENERGY SALES 1966-1995
CONSUMERS POWER
(GWh)

	Year	Annual Sales
	1966	15,128
12	1967	16,029
	1968	16,827
	1969	17,667
	1970	18,154
2	1971	19,632
	1972	21,133
	1973	22,995
	1974	22,507
	1975	22,145
12	1976	23,722
	1977	24,571
	1978	25,237
7	1979	25,707
	1980	24,533
	1981	24,141
	1982	24,659
	1983	27,160
	1984	28,530
	1985	29,870
	1986	30,630
	1987	31,520
12	1988	32,440
	1989	33,360
	1990	34,340
	1991	35,100
	1992	36,260
	1993	37,530
	1994	38,740
	1995	40,030

4

TABLE 1.1-4
REGRESSION MODELS USED FOR THE 10/80 MAIN SYSTEM ELECTRIC SALES FORECAST

Commercial Sales (COM)

COM = -10866.2 + 8195.76 * ln(real disposable income per capita) + 1446.44 * ln(real price of gas) - 1489.89 * ln(real price of electricity)
(-25.13) (17.25) (5.123) (-5.911)

- 993.26 * ln(lagged real price of electricity) - 496.63 * ln(2-yr lagged real price of electricity)
(-5.911) (-5.911)

T-stat in parenthesis
1979 model
Time frame 1965-80
R^2 = .9964
DW = 2.1124

Industrial Other Sales (INDO)

INDO = -727.238 + 5.70673 * real GNP - 0.329458 * real price of electricity - 0.219639 * lagged real price of electricity - 0.109819 * 2-yr
(-4.888) (39.83) (-5.849) (-5.849) (-5.849)

lagged real price of electricity - 50[illegible]328 * 1980 proxy for economic slump in Michigan
([illegible].258)

T-stat in parenthesis
1979 model except for proxy
12 Time frame 1963-80
R^2 = .9917
DW = 1.7691

GM Sales

Delta GM Sales = 43.8265 * ln(real capital stock of plant & equipment-automotive) + 0.295910 * delta GM auto & truck production - 0.832013 *
(4.883) (12.30) (-3.302)

delta real price of electricity - 334.090 * 1979 proxy for price effect
(-3.227)

T-stat in parenthesis
1979 model except for proxy
Time frame 1965-80
R^2 = .9519
DW = 1.8953

Total Residential Customers (RESC)

Delta RESC = -14909.0 + 805.468 * delta CP service territory adult population + 6810.78 * delta national housing stock + 83[illegible]8.99 * housing
(-3.493) (5.831) (4.073) ([illegible].800)

demand proxy

T-stat in parenthesis
1979 model
Time frame 1961-80
R^2 = .8152
DW = 2.3323
Note: Housing demand proxy = 1 for 1961-73; 0 for 1974 & after

TABLE 1.1-7

12 ACTUAL MONTHLY MAIN SYSTEM ELECTRIC SALES[a]

CONSUMERS POWER
(GWh)

	Month	1972	1973	1974	1975	1976	1977	1978	1979	1980
11	January		1891	1885	1886	1971	2099	2122	2245	2141
	February		1970	1884	1899	2053	2141	2173	2296	2127
	March		1931	1841	1781	1899	1998	2086	2207	2103
	April		1859	1819	1814	1881	1939	1991	2112	2037
	May		1821	1782	1658	1905	1886	1896	2041	1847
	June		1849	1801	1774	1886	2016	2033	2104	1870
	July		1920	1859	1867	1970	2061	2061	2115	1955
12	August		1879	1952	1914	1904	2046	2082	2093	2028
	September		2025	1932	1905	2021	2016	2189	2119	2064
	October	1774	1900	1895	1800	1916	1999	2095	2039	1997
	November	1907	1996	1910	1888	2127	2143	2194	2154	2107
	December	1935	1954	1948	1959	2189	2227	2314	2182	2254

11 (a)Sales exclude adjustment for unbilled sales.

TABLE 1.1-8

FORECAST OF MONTHLY ELECTRIC SALES AND PERCENT DEVIATION FROM ACTUAL

CONSUMERS POWER

		1972		1973		1974		1975		1976		1977		1978		1979		1980	
	Month	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev	GWh	% Dev
11	January			1880	(0.6)	2001	6.2	1964	4.1	1963	(0.4)	2044	(2.6)	2105	(0.8)	2175	(3.1)	2232	4.3
	February			1959	(0.6)	2082	10.5	2042	7.5	2000	(2.6)	2116	(1.2)	2186	0.6	2210	(3.8)	2284	7.4
	March			1883	(2.5)	2018	9.6	1968	10.5	1930	1.6	2020	1.1	2120	1.6	2130	(3.5)	2198	4.5
	April			1868	0.5	1985	9.1	1931	6.4	1916	1.9	2003	3.3	2107	5.8	2094	(0.8)	2164	6.2
	May			1797	(1.3)	1925	8.0	1888	13.9	1860	(2.4)	1899	0.7	2003	5.7	2039	(0.1)	2088	13.0
	June			1836	(0.7)	1956	8.6	1909	7.6	1889	0.2	1957	(2.9)	2080	2.3	2081	(1.1)	2144	14.7
	July			1817	(5.4)	1995	7.3	1933	3.5	1937	(1.7)	2003	(2.8)	2105	2.1	2141	1.[illegible]	2174	11.2
	August			1887	0.4	2036	4.3	1970	2.9	1926	1.2	1976	(3.4)	2082	0.0	2122	1.4	2191	8.0
12	September			1922	(5.1)	2048	6.0	2027	6.4	1992	(1.4)	2051	1.8	2223	1.5	2190	3.3	2266	9.8
	October	1797	1.3	1906	0.3	2057	8.6	2022	12.4	1959	2.3	1997	(0.1)	2083	(0.6)	2104	3.2	2192	9.8
	November	1825	(4.3)	1951	(2.3)	2106	10.3	2104	11.4	2066	(2.9)	2093	(2.3)	2167	(1.2)	2237	3.9	2233	6.0
	December	1880	(2.9)	2003	2.5	2142	10.0	2123	8.3	2077	(5.1)	2165	(2.8)	2252	(2.7)	2301	5.4	2291	1.6

2 Notes: Positive deviation indicates that forecast was higher than actual.

12 Monthly gigawatthour forecasts are finalized in August of the preceding year; subsequent revisions are not reflected.

TABLE 1.1-9

CAPABILITY AT ANNUAL PEAK
(Seasonal Deratings Not Included)
(MW)

		Consumers Power[a]				Consumers Power-Detroit Edison				ECAR (Bulk)[b]		
12	Year	Installed Capability	Ludington Lease	Purchases (Sales)	Net Capability	Installed Capability	Ludington Lease	Purchases (Sales)	Net Capability	Installed Capability	Net Interchange	Net Capability
	1971	3,828	-	766	4,594	10,617	-	185	10,802	51,359	148	51,507
	1972	4,153	-	481	4,634	11,166	-	764	11,930	57,138	(653)	56,485
	1973	5,230	(255)	(71)	4,904	14,294	(300)	1,069	15,063	63,776	(154)	63,622
	1974	5,364	(76)	60	5,348	14,711	(150)	312	14,873	67,753	624	68,377
2	1975	5,742	(306)	(28)	5,408	14,817	(450)	1,207	15,574	74,188	(1,537)	72,651
	1976	5,742	(318)	20	5,444	14,940	(624)	520	14,836	75,713	(1,380)	74,333
	1977	5,721	(318)	270	5,673	14,483	(624)	620	14,479	79,326	(1,775)	77,551
	1978	6,488	(318)	20	6,190	15,540	(624)	620	15,536	86,012	(1,183)	84,829
	1979	6,240	(318)	220	6,142	15,384	(624)	420	15,180	83,380	(46)	83,334
	1980	6,146	(318)	245	6,073	14,649	(624)	720	14,745	85,932	(495)	85,437
12	1981	6,703	(318)	45	6,430	16,289	(624)	45	15,710	89,959	21	89,980
	1982	6,703	(318)	42	6,427	16,289	(624)	42	15,707	93,699	37	93,736
	1983	6,703	(318)	38	6,423	16,289	(624)	38	15,703	96,639	410	97,049
	1984	7,918	(159)	32	7,791	18,378	(312)	170	18,236	102,116	410	102,526
	1985	7,918	(159)	39	7,798	19,042	(312)	158	18,888	105,269	319	105,588
	1986	7,918	(159)	37	7,796	19,706	(312)	136	19,530	108,805	(81)	108,724

12 (a) Consumers Power has been summer [illegible]aking generally, but experienced winter peaks in 1971, 1972, 1975 and 1976. Data for 1978-1986 are for summ[illegible] critical load season.

(b) ECAR data is based on report [illegible]itled "Regional Reliability Council Coordinated Bulk Supply Program", ERA-411, Volume II.

TABLE 1.1-10 1 of 2

GENERATING CAPABILITY AT TIME OF PEAK-1971
CONSUMERS POWER

	Unit	MW	Type	Function
	Campbell 1	275	Coal-Steam	Base Load
	Campbell 2	372	Coal-Steam	Base Load
	Cobb 1	68	Coal-Steam	Base Load
	Cobb 2	68	Coal-Steam	Base Load
	Cobb 3	68	Coal-Steam	Base Load
	Cobb 4	162	Coal-Steam	Base Load
	Cobb 5	165	Coal-Steam	Base Load
	Elm Street	32	Coal-Steam	Intermediate
	Kalamazoo	23	Coal-Steam	Intermediate
	Karn 1	275	Coal-Steam	Base Load
	Karn 2	275	Coal Steam	Base Load
2	Morrow 1	41	Oil-Steam	Intermediate
	Morrow 2	41	Oil-Steam	Intermediate
	Morrow 3	60	Oil-Steam	Intermediate
	Morrow 4	68	Oil-Steam	Intermediate
	Saginaw River 3	34)	Coal-Steam	Intermediate
	Saginaw River 4	46) (a)	Coal-Steam	Intermediate
	Saginaw River 5	41)	Coal-Steam	Intermediate
	Weadock 1	42)	Oil-Steam	Intermediate
	Weadock 2	42)	Oil-Steam	Intermediate
	Weadock 3	62)	Oil-Steam	Intermediate
	Weadock 4	62) (b)	Oil-Steam	Intermediate
	Weadock 5	72)	Oil-Steam	Intermediate
	Weadock 6	72)	Oil-Steam	Intermediate
	Weadock 7	162	Coal-Steam	Base Load
	Weadock 8	165	Coal-Steam	Base Load
	Wealthy Street	23	Coal-Steam	Intermediate
	Whiting 1	106	Coal-Steam	Base Load
	Whiting 2	106	Coal-Steam	Base Load
	Whiting 3	133	Coal-Steam	Base Load

TABLE 1.[illegible]-10 2 of 2

Unit	MW	Type	Function
Big Rock	71	Nuclear	Base Load
2 Hydro	134(c)	Run of River Hydro	Intermediate
Diesels and Peakers	523(d)	Internal Combustion & Combustion Turbine	Peaking
TOTAL	3828		

Notes:
(a) Saginaw River 3-5 were boiler limited at 80 MW.
(b) Weadock 1-6 were boiler limited at 332 MW.
(c) 35 hydro units ranging from 0.4 MW to 10.8 MW.
(d) 20 combustion turbines ranging from 20 MW to 44 MW plus one diesel of 1 MW.

11 TABLE 1.1-11 1 of 5

HISTORICAL AND PROJECTED CAPABILITY CHANGES AND LONG-TERM TRANSACTIONS
CONSUMERS POWER - DETROIT EDISON

Rev.	Year	Date	Item	MW Change
	1971	As of Dec 31	Total Installed Capability (1972 ECAR Response (dated 4/78) to FPC Docket R-362, Order 383-2)	10,866
			CP Purchase: Dow Chemical Co-Ludington	4
			CP Purchase: Wolverine Power Corp	11
			DE Purchase: Ford Motor Co	45
			Ontario Hydro Diversity	(200)
2	1972	Feb 1	Saginaw River Plant Retired (CP-Coal)	(80)
		Feb 13	OH Diversity Ends	200
		Mar 7	Palisades Initial Rating (CP-Nuclear)	80
		Apr 1	Conners Creek Plant	(12)
		Apr 7	Palisades Uprate	315
		May 1	DECo System Rerate	(3)
		May 29	OH Diversity Begins	200
		Sept 17	OH Diversity Ends	(200)
		Oct 30	OH Diversity Begins	(300)
		Nov 1	Palisades Uprate	10
		Dec 16	Palisades Uprate	93
		Dec 22	Palisades Uprate	87
		Dec 31	Allegan Diesel Retired (CP)	(1)
		Dec 31	Kalamazoo Retired (CP-Coal)	(23)
		Dec 31	Wealthy St Retired (CP-Coal)	(23)
		Dec 31	Conners Creek Plant	(17)
		Dec 31	Marysville Plant	(134)
12	1973	Jan 18	Ludington 1 (CP/DE)[a]	325
		Jan 19	Monroe 2	770
		Feb 6	Trenton Channel Retirement	(47)
2		Feb 18	OH Diversity Ends	300
		Feb 26	Trenton Channel Retirement	(27)
12		Mar 19	Ludington 2 (CP/DE)[a]	325
		Mar 31	Palisades Uprate (CP-Nuclear)	70
		Apr 5	Monroe 3	470
2		Apr 7	Palisades Uprate (CP)	39
		Apr 13	Palisades Uprate (CP)	6
12		May 1	Ludington 3 (CP/DE)[a]	325
2		May 28	OH Diversity Begins	100
		June 1	Dow Ludington	5
12		June 11	Ludington 4 (CP/DE)[a]	300

	Year	Date	Item	MW Change
12	1973	June 18	Ludington 4 Uprate (CP/DE)[a]	25
		July 3	Monroe 3 Uprate	80
2		July 5	Monroe 3 Uprate	70
		July 14	Monroe 3 Uprate	80
12		Aug 7	Ludington 5 (CP/DE)[a]	325
		Aug 7	Lease of 1/3 of Ludington Capability to CE Begins	(541)
		Aug 31	Elm St Plant (CP-Coal)	(32)
2		Sept 16	OH Diversity Ends	(100)
		Sept 30	Conners Creek Plant	(66)
		Sept 30	Trenton Channel Plant	(142)
		Oct 1	Sale to TECo Begins	(200)
12		Oct 1	Ludington 6 (CP/DE)[a]	325
		Oct 1	Lease of 1/3 of Additional Ludington Capability to CE	(108)
		Nov 1	DECo System Rerate	(372)
	1974	May 1	DECo System Rerate	(46)
		May 8	Monroe 4	750
		Oct 1	Palisades-Cooling Tower Rerate (CP)	(14)
		Oct 1	Trenton Channel 2 & 4 Retired	(108)
		Oct 1	Trenton Channel 7 & 8 Rerated	(44)
		Oct 6	Sale to TECo Terminated	200
		Nov 1	DECo System Rerate	47
		Nov 1	DE Purchase From Ford Motor Co No Longer Counted	(45)
	1975	Jan 26	Karn 3 Initial Rating (CP-Oil)	450
		May 1	CPCo System Rerate	(107)
2		May 1	DECo System Rerate	22
		May 1	Karn 3 Derate (CP)	(50)
		July 1	Marysville Plant Derate	(44)
		July 16	Karn 3 Uprate (CP)	100
		Aug 1	DECo System Rerate	(146)
		Oct 20	Wyandotte South Returned to Customer	(15)
		Nov 1	Delray Plant Rerate	30
	1976	Jan 1	Purchase of Gavin Unit Power Begins (CP)	250
		Mar 31	Purchase of Gavin Unit Power Terminated (CP)	(250)
		Apr 1	Purchase of Gavin Unit Power Begins (CP/DE)	500
		May 1	DECo System Rerate	112
		Sept 30	Purchase of Gavin Unit Power Terminated (CP/DE)	(500)
		Nov 1	DECo System Rerate	73
	1977	Jan 1	Big Rock Derate (CP)	(10)
		Jan 1	Palisades (CP)	(11)
		Jan 1	River Rouge & St Clair Rerate (DE)	(434)
		Mar 1	Trenton Channel Rerate (DE)	5

	Year	Date	Item	MW Change
	1977	May 1	Conners Creek & Delray Rerate (DE)	(80)
		Sept 6	Wyandotte North Returned to Customer (DE)	(23)
		Sept 30	Karn 4 (CP-Oil)	620
		Nov 1	DE System Rerate	312
		Dec 1	Palisades Uprate (CP)	55
		Dec 1	Morrow Uprate (CP)	10
	1978	Jan 1	Karn 4 Derate (CP)	(120)
		Feb 1	Campbell 1 Derate (CP)	(4)
		Apr 1	Karn 1 Derate (CP)	(3)
		Apr 1	Karn 2 Derate (CP)	(3)
		Apr 1- Sept 30	Unit Pwr (DE)	200
		Apr 1- Oct 31	Unit Pwr (DE)	200
		May 1	Karn 3 Uprate (CP)	100
		May 1	Karn 4 Uprate (CP)	100
		May 1	Palisades Uprate (CP)	10
		May 1	Big Rock Uprate (CP)	2
11		May 12- Sept 17	Short Term (DE)	200
		Nov 1	Derate St Clair 5-7 (DE)	(155)
	1979	Jan 1	Campbell 2 Derate (CP)	(20)
		Jan 1	Fermi 1 Economy Reserve (DE)	(161)
7		Jan 1	Delray LP Economy Reserve (DE)	(151)
		Apr 1	Morrow 1-4 Economy Reserve (CP)	(76)
		Apr 1	Weadock 1-6 Economy Reserve (CP)	(131)
11		Apr 1	Whiting 1 (CP)	(21)
		May 1	Trenton Ch 9 (DE)	(40)
		May 21- Sept 16	Short Term (DE)	200
10		June 4- Oct 28	Short Term (CP)	200
12		July 5	Greenwood 1 (DE)	600
		Oct 1	CP System Rerate	(107)
		Nov 1	Greenwood 1 Uprate (DE)	50
		Dec 1	Greenwood 1 Uprate (DE)	75
	1980	Jan 1	Greenwood 1 Uprate (DE)	35
		Jan 1	Karn 4 Uprate (CP)	13
		Jan 1	Conners Creek LP Economy Reserve (DE)	(175)
11		Feb 1	River Rouge 1 Economy Reserve (DE)	(206)
		Feb 1	St Clair 5 Economy Reserve (DE)	(250)
		Apr 1	Delray 16 Economy Reserve (DE)	(69)
		May 1	DE System Rerate	(101)
		May 1- Oct 31	Short Term (DE)	200
		May 5- Aug 31	Short Term (DE)	100

	Year	Date	Item	MW Change
	1980	May 5- Sept 4	Limited Term (CP)	50
11		May 5- Sept 14	Short Term (CP)	175
		May 5- Sept 14	Short Term (DE)	175
		Sept 26	Campbell (CP-Coal)	740
		Sept 26	Sale of Campbell 3	(50)
12		Sept 26	Buy Back of Excess Campbell 3	36
		Nov 1	Rerate (DE)	36
	1981	Jan 1	Weadock 1-6 Economy Reserve (CP)	(189)
11		Jan 1	Campbell 2 Uprate (CP)	20
		Jan 1	Greenwood 1 Uprate (DE)	20
		Jan 1	Campbell 3 Uprate	38
12		Jan 1	Sale of Campbell 3 Uprate	(2)
		Jan 1	Buy Back Campbell 3 Changed to 34 MW	(2)
11		Jan 1	DE Units Returned From Economy Reserve	1,012
		Jan 1	Termination Dow Ludington Purchase (CP)	(9)
		May 1	Remer (DE)	14
	1982	Jan	Buy Back Campbell 3 Changed to 31	(3)
	1983	Jan	Buy Back Campbell 3 Changed to 27	(4)
		Aug	Lease of 1/6 of Ludington Capability to CE Ends	312
		Dec	Midland 2 (CP)	807
		Dec	Fermi 2 (DE)	1,093
		Dec	Sale of Fermi 2	(219)
		Dec	Buy Back of Excess Fermi 2	158
12		Dec	Morrow 3-4 Placed on Economy Reserve	(114)
	1984	Jan	Buy Back Campbell 3 Changed to 21	(6)
		Jan	Buy Back Fermi 2 Changed to 138	(20)
		July	Midland 1 (CP)	522
		July	Belle River 1 (DE)	644
	1985	Jan	Buy Back Campbell 3 Changed to 28 MW	7
		Jan	Buy Back Fermi 2 Changed to 119	(19)
		July	Belle River 2 (DE)	664

11 TABLE 1.1-11 5 of 5

Year	Date	Item	MW Change
12 1986	Jan	Buy Back Campbell 3 Changed to 26 MW	(2)
11	Jan	Buy Back Fermi 2 Changed to 99 MW	(20)

12 (a) Consumers Power owns 51% of the Ludington Pumped Storage Plant and Detroit
11 Edison owns 49%.

TABLE 1.1-12

CAPACITY FACTORS OF UNITS
1 PROJECTED FOR SERVICE IN 1984

2 CONSUMERS POWER

	Unit	MW	Type	Function	Range of Capacity Factor
11	Campbell 1	253	Coal-Steam	Base Load	65-80
	Campbell 2	349	Coal-Steam	Base Load	65-80
12	Campbell 3[a]	726	Coal-Steam	Base Load	65-75
	Cobb 1-3	180	Coal-Steam	Base Load	50-65
	Cobb 4	151	Coal-Steam	Base Load	65-80
	Cobb 5	152	Coal-Steam	Base Load	65-80
	Karn 1	255	Coal-Steam	Base Load	65-80
11	Karn 2	257	Coal-Steam	Base Load	65-80
	Karn 3	638	Oil-Steam	Intermediate	5-30
	Karn 4	613	Oil-Steam	Intermediate	5-30
	Midland 1[a]	522	Nuclear	Base Load	60-75
	Midland 2[a]	807	Nuclear	Base Load	60-75
12					
11	Palisades	740	Nuclear	Base Load	60-75
12					
	Weadock 7	155	Coal-Steam	Base Load	65-80
	Weadock 8	155	Coal-Steam	Base Load	65-80
	Whiting 1	95	Coal-Steam	Base Load	65-80
11	Whiting 2	95	Coal-Steam	Base Load	65-80
	Whiting 3	120	Coal-Steam	Base Load	65-80
	Big Rock	63	Nuclear	Base Load	60-75
12	Hydro	134[b]	Run of River		
11			Hydro	Intermediate	25-35
12	Ludington 1-6	955[c]	P Storage		
11			Hydro	Peaking	15-20
12	Peakers	504[d]	Jet or Comb		
			Turbine	Peaking	5-20

11

(a) Units not existing in 1976 but projected for operation by 1984.
(b) 35 units ranging from 0.4 MW to 10.8 MW.
12 (c) 6 units of 312 MW each. Consumers Power Company share 51%.
(d) 20 turbines ranging from 19 MW to 42 MW.

TABLE 1.1-13

GENERATING UNIT
AVAILABILITIES AND MAINTENANCE
11 1984

CONSUMERS POWER

	Unit(s)	Availability %	Periodic Maintenance Weeks
	Campbell 1	68.0	10
11	Campbell 2	76.8	3
	Campbell 3	79.4	4
12	Cobb 1-3	83.1	4
	Cobb 4	83.4	3
	Cobb 5	85.1	3
11			
	Karn 1	74.0	4
	Karn 2	79.0	3
	Karn 3	81.7	4
	Karn 4	79.9	4
12			
	Weadock 7	87.1	3
	Weadock 8	83.4	3
	Whiting 1	79.7	6
11	Whiting 2	90.1	2
	Whiting 3	86.4	2
	Big Rock	84.4	6
	Palisades	62.1	9
	Midland 1	63.6	2
12	Midland 2	63.7	0
	Hydro	94.4	1
	Comb Turbines	79.2	3
	Ludington Pumped Storage	93.0	2

TABLE 1.1-14

MONTHLY LOAD MODEL USED IN RELIABILITY ASSESSMENTS CONSUMERS POWER

Daily Peaks - Per Unit of Monthly Peak

	Mo	Monthly Peak (Fraction of Yearly Peak)	1	2	3	4	5	6	7	8	9	10	11	12
	Jan	.936	1.0000	0.9969	0.9899	0.9784	0.9770	0.9733	0.9716	0.9674	0.9667	0.9660	0.9635	0.9597
	Feb	.912	1.0000	0.9875	0.9817	0.9805	0.9731	0.9707	0.9678	0.9674	0.9674	0.9652	0.9635	0.9563
11	Mar	.879	1.0000	0.9916	0.9880	0.9799	0.9720	0.9704	0.9699	0.9669	0.9659	0.9631	0.9628	0.9618
	Apr	.857	1.0000	0.9840	0.9758	0.9758	0.9673	0.9642	0.9634	0.9632	0.9601	0.9601	0.9557	0.9544
	May	.896	1.0000	0.9395	0.9263	0.9049	0.9040	0.9008	0.8992	0.8963	0.8927	0.8917	0.8838	0.8807
	June	.940	1.0000	0.9835	0.9680	0.9410	0.9317	0.9278	0.9271	0.9222	0.9058	0.8972	0.8861	0.8829
10	July	1.000	1.0000	0.9527	0.9503	0.9453	0.9280	0.9049	0.8911	0.8898	0.8848	0.8725	0.8642	0.8625
11	Aug	.972	1.0000	0.9855	0.9443	0.9410	0.9320	0.9290	0.9051	0.9013	0.9002	0.8978	0.8960	0.8949
10	Sept	.930	1.0000	0.9800	0.9685	0.9568	0.9275	0.9193	0.9071	0.8978	0.8971	0.8830	0.8817	0.8624
12	Oct	.901	1.0000	1.0000	0.9985	0.9916	0.9902	0.9872	0.9850	0.9831	0.9823	0.9799	0.9787	0.9782
13	Nov	.955	1.0000	0.9928	0.9912	0.9884	0.9875	0.9752	0.9713	0.9581	0.9551	0.9510	0.9500	0.9408
11	Dec	.965	1.0000	0.9981	0.9963	0.9952	0.9931	0.9842	0.9828	0.9783	0.9778	0.9716	0.9703	0.9687

Mo	13	14	15	16	17	18	19	20	21	22	23	24
Jan	0.9571	0.9569	0.9557	0.9489	0.9482	0.9419	0.9323	0.7594	0.7519	0.7316		
Feb	0.9540	0.9528	0.9489	0.9453	0.9417	0.9393	0.9202	0.9187				
Mar	0.9608	0.9529	0.9501	0.9458	0.9435	0.9430	0.9338	0.9310	0.9226	0.9221	0.7677	
Apr	0.9526	0.9508	0.9385	0.9320	0.9297	0.9277	0.9251	0.9220				
May	0.8804	0.8795	0.8778	0.8756	0.8752	0.8725	0.8713	0.8708	0.8701	0.8627	0.7211	
June	0.8746	0.8730	0.8725	0.8679	0.8662	0.8591	0.8584	0.8521	0.8459	0.8318		
July	0.8535	0.8500	0.8295	0.8212	0.8181	0.8124	0.7984	0.5801	0.5293			
Aug	0.8919	0.8794	0.8724	0.8685	0.8668	0.8648	0.8635	0.8596	[illegible]	0.8554	0.8076	
Sept	0.8559	0.8537	0.8472	0.8449	0.8405	0.8403	0.8362	0.8351	0.6206			
Oct	0.9779	0.9765	0.9750	0.9750	0.9721	0.9711	0.9696	0.9662	0.9545	0.9508		
Nov	0.9380	0.9348	0.9285	0.9258	0.9235	0.9200	0.9142	0.8969	0.7305	0.6933		
Dec	0.9648	0.9609	0.9363	0.9230	0.8130	0.8071	0.7831	[illegible]	0.6005			

1.2 OTHER OBJECTIVES

In addition to generating electricity, the Midland Plant will furnish up to 4,050,000 and not less than 1,400,000 pounds per hour of process steam for sale to The Dow Chemical Company. Furnishing steam and power to Dow will
3 permit shutdown of power plants now operated by Dow to provide electricity and steam for its chemical processing operations at Midland, Michigan. At the present time, these power plants burn oil, coal and natural gas. Under its existing Consent Order with the State of Michigan, The Dow Chemical Company is required to be in compliance with State Emission Standards R336.41, R336.44 and R336.49 of the Michigan Administrative Code, Air Pollution Control
12 Commission, General Rules by December 31, 1982. (Note: These rules were amended and renumbered July 17, 1980 as R336.1301, R336.1331 and R336.1401, respectively.)

1.3 CONSEQUENCES OF DELAY

12 A delay in the in-service dates of the Midland Plant Units 1 and 2 will decrease the reliability level on the Consumers Power system as well as the groups of which it is a member. Assuming a one-, two- or three-year delay in
2 the commercial operation dates of the Midland Plant results in the following reserve percentages for the Consumers Power system:

4

Year	No Delay	1-Year Delay	2-Year Delay	3-Year Delay
1984	44.3	21.8	21.8	21.8
1985	38.1	38.1	23.8	23.8
1986	34.6	34.6	34.6	20.6

12

Based on Section 1.1.3.2, Consumers Power system requires 23 percent reserve over summer peak to support an average 1 day/10 years LOLE.

2 Similar data for the Consumers Power-Detroit Edison system are:

4

Year	No Delay	1-Year Delay	2-Year Delay	3-Year Delay
1984	34.4	25.6	25.6	25.6
1985	34.3	34.3	28.7	28.7
1986	35.0	35.0	35.0	29.5

12

Based on Section 1.1.4, the Consumers Power-Detroit Edison coordination agreement does not obligate either party to a particular reserve level.

2 Tables 1.3-1 and 1.3-2 detail the development of the above data.

11

11 In the 1984 through 1986 period considered, ECAR's indicated reserves (including interruptible load) and the estimated effect of the above delays on
12 those reserves are (based on "Appraisal of ECAR-Wide Installed Reserves for the Period 1980-1989", Interim Report No 80-3):

	Year	No Delay	1-Year Delay	2-Year Delay	3-Year Delay
11					
	1984	31.7	30.1	30.1	30.1
12	1985	33.1	33.1	32.1	32.1
	1986	32.4	32.4	32.4	31.4

2

12 Based on Section 1.1.4, the ECAR systems would require 40 percent reserves over summer peak. These reserves are based on an experienced generating unit unavailability of 30 percent and in order to obtain a historical average 4 days/year LOLE.

TABLE 1.3-1

EFFECT OF MIDLAND DELAY ON RESERVES[a]

CONSUMERS POWER COMPANY
(Summer; in MW)

	Year		As Scheduled	Delay[b] 1 Year	Delay[c] 2 Years	Delay[d] 3 Years
12 10						
	1984	Cap	7484	6310	6310	6310
		Purch	21	21	21	21
		Net Cap	7505	6331	6331	6331
		Load	5200	5200	5200	5200
		Res	2305	1131	1131	1131
		% Res	44.3	21.8	21.8	21.8
	1985	Cap	7484	7484	6706	6706
		Purch	28	28	28	28
12		Net Cap	7512	7512	6734	6734
		Load	5440	5440	5440	5440
		Res	2072	2072	1294	1294
		% Res	38.1	38.1	23.8	23.8
	1986	Cap	7484	7484	7484	6706
		Purch	26	26	26	26
		Net Cap	7510	7510	7510	6732
		Load	5580	5580	5580	5580
		Res	1930	1930	1930	1152
		% Res	34.6	34.6	34.6	20.6

4 (a)Assumes 1.5 x 10^6 lb/h steam flow to The Dow Chemical Company.

(b)Economy Reserve Morrow 3-4 delayed until December 1984.

12 (c)Economy Reserve Morrow 3-4 delayed until December 1985.
Reactivate Weadock 1-6 and Morrow 1-2 for the year 1985.

(d)Economy Reserve Morrow 3-4 delayed until December 1986.
Reactivate Weadock 1-6 and Morrow 1-2 for the years 1985-1986.

TABLE 1.3-2

EFFECT OF MIDLAND DELAY ON RESERVES[a]

CONSUMERS POWER COMPANY-DETROIT EDISON
(Summer; in MW)

	Year		As Scheduled	Delay[b] 1 Year	Delay[c] 2 Years	Delay[d] 3 Years
12, 10						
	1984	Cap	17635	16461	16461	16461
		Purch	159	159	159	159
		Net Cap	17794	16620	16620	16620
		Load	13237	13237	13237	13237
		Res	4557	3383	3383	3383
		% Res	34.4	25.6	25.6	25.6
	1985	Cap	18299	18299	17521	17521
		Purch	147	147	147	147
12		Net Cap	18446	18446	17668	17668
		Load	13730	13730	13730	13730
		Res	4716	4716	3938	3938
		% Res	34.3	34.3	28.7	28.7
	1986	Cap	18963	18963	18963	18185
		Purch	125	125	125	125
		Net Cap	19088	19088	19088	18310
		Load	14141	14141	14141	14141
		Res	4947	4947	4947	4169
		% Res	35.0	35.0	35.0	29.5

4 (a)Assumes 1.5×10^6 lb/h steam flow to The Dow Chemical Company.

(b)Economy Reserve Morrow 3-4 delayed until December 1984.

12 (c)Economy Reserve Morrow 3-4 delayed until December 1985. Reactivate Weadock 1-6 and Morrow 1-2 for the year 1985.

(d)Economy Reserve Morrow 3-4 delayed until December 1986. Reactivate Weadock 1-6 and Morrow 1-2 for the years 1985-1986.

CHAPTER 2

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CHAPTER 2

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Locations shown on construction drawings are all related to local site coordinates. Local site coordinates can be converted to Michigan State plane coordinates south zone by the relationships:

$$SPN = 765{,}133.567 + SN \cos B + SE \sin B \qquad (2.1\text{-}1)$$

$$SPE = 2{,}029{,}080.624 - SN \sin B + SE \cos B \qquad (2.1\text{-}2)$$

Where:

SPN = State Plane North Coordinate

SPE = State Plane East Coordinate

SN = Site North Coordinate

SE = Site East Coordinate

B = 0°-2'-57.9331"

2.1.1.2 Site Area Map

The Plant property line, which is also the site boundary, is shown in Figure
12 2.1-1. The site encompasses approximately 1,235 acres. There are no industrial, commercial, institutional, recreational or residential structures within the site boundary.

The Plant exclusion area is discussed in Section 2.1.1.3.2.

The Plant is bordered to the north and east by the Tittabawassee River. A railroad spur for Plant use, which connects to the Chesapeake and Ohio main lines, crosses the Tittabawassee River east of the Plant and runs westerly to the Plant (see Figure 2.1-1).

Gordonville Road, which is the only road immediately adjacent to the Plant, runs along the southern property line next to the cooling pond. The only access road to the Plant is from Poseyville Road. It joins Miller Road west

of the property line as shown in Figure 2.1-1. This access road off of Poseyville Road is provided with a bridge over Bullock Creek built solely for Plant use and is located in the southern half of Section 28.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary used to establish technical specification limits for the release of gaseous effluents from the Midland Plant is the exclusion area boundary and the perimeter fence where the exclusion area boundary is within the perimeter fence. The perimeter fence is located outboard of the patrol road on top of the outer dikes. See Figure 2.1-1 for layout of the exclusion area and the top of the dike and Section 2.1.1.3.2 for a description of the exclusion area.

The nearest gaseous release point to the described boundary is the auxiliary building stack which is located approximately at the northernmost edge of the Unit 2 containment. The minimum distance of this release point to the boundary is 500 meters (see Figure 2.1-1).

Virtually the entire Plant site is enclosed by the perimeter fence to control casual access. In addition, there is a fenced-in area surrounding the immediate Plant area within the Midland Plant. Access to the Plant area will be continuously and actively controlled by Consumers Power Company. Only specifically authorized personnel will be permitted access to the Plant area.

The area between the perimeter fence and the water's edge in the case of the Tittabawassee River and the top of the northwesterly bank in the case of Bullock Creek is owned in fee by Consumers Power Company. There is no commercial river traffic and infrequent pleasure boat traffic on the adjoining water areas.

2.1.1.3.1 Dow Chemical Company Property

Two parcels of property owned by Dow Chemical Company are included within the exclusion area: the tertiary wastewater treatment pond west of the containments across Bullock Creek and the clarifier area north of the containments across the Tittabawassee River (see Figure 2.1-1). Normally, there will be no persons working in the Dow-owned portion of this area.
12 Access to these portions will be controlled at normal Plant gates and Dow personnel or contractors entering the area will be controlled by, and in contact with, Dow security personnel. The Dow Security Communication Center is continuously manned by a minimum of two persons and will have direct communication with Consumers Power Company's Midland Plant.

2.1.1.3.2 Exclusion Area Description

1 The exclusion area is a racetrack-shaped area with radii of 519 meters centered on each of the containment buildings. The minimum distance from the outside face of either of the containment buildings to the nearest edge of the exclusion area is 500 meters. See Figure 2.1-1 for layout of the exclusion area on the property.

The majority of the area is owned by Consumers Power Company. The exclusion area as shown in Figure 2.1-1 includes two segments of land owned by Dow and portions of the Tittabawassee River and Bullock Creek. With respect to ownership of property within the exclusion area owned by Dow, Dow has made the following statement:

> All Dow Chemical Company property which is situated within the 500-meter radius is owned, in fee simple, by The Dow Chemical Company. This determination was made after a thorough examination of pertinent property records by qualified personnel.

There are no public roads remaining within the Plant site boundaries or the exclusion area. Those portions of Miller Road, Sasse Road, River Road and Stewart Road which previously traversed the site have been abandoned by governmental action. The access road across the south 1/2 of Section 28 from the Plant to Poseyville Road is a private road owned, maintained and controlled by Consumers Power.

2.1.2 Population Distribution

2.1.2.1 Population Within 10 Miles

Within 10 miles of the Plant, the 1970 estimated population was 72,706; within 5 miles, there were 48,501 residents. The following communities are the only significant population groupings within 10 miles of the Plant:

Community	Population	Location
Auburn	1,919	7 mi E
Midland	34,921	Power Block Annexed by City, 4
Sanford	818	9 mi NW

Figure 2.1-2 shows the location of these communities relative to the Plant.

Estimates of the 1970 resident population within 5 miles of the Plant are determined from Electrical Service Distribution maps[(1)] which show the location of each residential service. The number of persons per residential service is assumed to be 3.5 based on the average number of persons per residential service[(2)] in the counties concerned:

Bay - 3.4

Midland - 3.5

Saginaw - 3.4

The 5- to 10-mile area population estimate is made by obtaining city and township populations from 1970 US census data[3] and distributing the population to the proper sectors. It is assumed that the population within each census unit was uniformly distributed.

Population projections for areas within 10 miles for the years 1980, 1990, 2000, 2010 and 2020 are based on corresponding projections for the individual counties concerned. It is assumed that each component (or fraction) of a county has the same decennial rate of growth as that for the county as a whole.

Bay, Midland and Saginaw are the only counties within 10 miles of the Plant. Projections by the Michigan Department of Management and Budget are available for 1970, 1980 and 1990[4]. The 1970-1980 and 1980-1990 decennial rates of growth derived from these projections are applied to the 1970 census data to obtain the projected 1980 and 1990 populations. The projected 2000, 2010 and 2020 populations of the counties are derived by assuming their decennial rate of growth from 1990-2020 to be declining compared to the average of the 1970-1980 and 1980-1990 rates of growth since the general population is expected to stabilize by year 2040. The projections are shown in Table 2.1-1.

Figure 2.1-3 shows the estimated 1970 population distribution within 10 miles of the Plant. Figures 2.1-4 through 2.1-8 show corresponding projected populations for the years 1980, 1990, 2000, 2010 and 2020. Population totals for each segment are shown on Table 2.1-2.

The age distribution within 10 miles for the current population[3] and
projected population for the year 2000 (nearest decade corresponding to the
midpoint of Plant operating life) are shown in Table 2.1-3. It is assumed
12 that the percent age distribution for year 2000 will be the same as that for
1970.

2.1.2.2 Population Between 10 and 50 Miles

The 1970 estimated population residing between 10 and 50 miles of the Plant is 941,707. The four cities with populations greater than 25,000 are:

Midland	34,921
Bay City	49,449
Saginaw	91,849
Flint	193,317

Table 2.1-4 lists all incorporated cities with populations greater than 1,000 within 50 miles of the Plant.[3] Figure 2.1-9 shows the 50-mile region surrounding the Midland Plant.

The 1970 population estimate for the 10- to 50-mile area is made by obtaining city and township populations from the 1970 US census data and distributing the population to the proper sectors. It is assumed that the population within each census unit was uniformly distributed.

Population projections for areas between 10 and 50 miles for the years 1980, 1990, 2000, 2010 and 2020 are based on corresponding projections for the individual counties concerned. It is assumed that each component (or fraction) of a county has the same decennial rate of growth as that for the county as a whole.

Projections by the Michigan Department of Management and Budget are available for 1970, 1980 and 1990[4]. The 1970-1980 and 1980-1990 decennial rates of growth derived from these projections are applied to the 1970 census data to obtain the projected 1980 and 1990 populations. The projected 2000, 2010 and 2020 populations of the counties are derived by assuming the decennial rate of growth from 1990-2020 to be declining compared to the average of the 1970-1980 and 1980-1990 rates of growth since the general population is expected to stabilize by year 2040 (refer to Table 2.1-5).

Figure 2.1-3 shows the estimated 1970 population distribution between 10 and 50 miles of the Plant. The population projections for the years 1980, 1990, 2000, 2010 and 2020 are given in Figures 2.1-4 through 2.1-8. Population totals for each segment are shown in Table 2.1-6.

The age distribution within 50 miles for the current population[3] and projected population for the year 2000 (nearest decade corresponding to the midpoint of Plant operating life) are shown in Table 2.1-7. It is assumed
12 that the percent age distribution for year 2000 will be the same as that for 1970.

2.1.2.3 Transient Population

Because of the large number of commercial and industrial establishments in the vicinity of the Plant, an estimate of the number of people engaged in business activities (ie, "daily transients") within each sector is shown in Table 2.1-8 and added to the resident population and shown in Table 2.1-9. The business loading is composed of employees and customers of the commercial or industrial establishments in the area.

The business loading per sector for the 0- to 5-mile area is determined by analyzing the electrical distribution maps(1). Commercial and industrial services are located relative to the sector grid system. Commercial establishments are considered to load the sector by 10 people and industrial establishments are considered on an individual basis. Churches and schools, other than high schools, are not considered in the business loading since they generally serve the adjacent area. The business loading for the 5- to 10-mile area is considered insignificant because of the primarily residential and farmland use.

The area 10 to 50 miles from the Plant is used primarily for farming where not forested except for the industrial communities of Bay City, Flint and Saginaw. A large portion of the area northeast of the Plant is public land used for hunting and fishing.

2.1.3 Uses of Adjacent Lands and Waters

2.1.3.1 Land Use Immediately Adjacent to the Midland Plant

This section describes land and water uses adjacent to the Midland Plant boundary. In this usage "adjacent" is defined as "uses which abut the Consumers Power Company property line and those uses within 1/2 mile from the property line." Land use information from Midland County and aerial photographs taken by Consumers Power Company were used to determine land and water uses immediately adjacent to the Midland Plant (see Figure 2.1-10).

The Tittabawassee River forms the north and east boundaries of the Plant property. The land use across the river is primarily industrial; this is the location of The Dow Chemical Company and Dow Corning Corporation complexes. The Dow complex provides a buffer zone about 2 miles wide between the Plant

and the commercial and residential areas of Midland. Dow Chemical Company's treatment pond is located across Bullock Creek which has been rerouted along the northwestern portion of the Midland Plant. To the south, the land use is primarily agriculture and woodland although there are also scattered residences located in that area.

The Plant site is comprised of approximately 1,235 acres presently owned by Consumers Power Company, 880 of which are developed as a cooling pond, and 10 of which comprise the area of the power block. The remaining land will be left in its existing state or will be landscaped to screen the Plant from
12 adjacent residential areas. An additional laydown area of 65 acres is located on the western border, south of Stewart Road and east of Poseyville Road. Consumers Power Company also owns a narrow strip of land northwest of the Plant site; along this corridor a road has been built for permanent access to the Plant.

The Plant buildings are located on the northernmost edge of the property. Therefore, the exclusion area includes part of Dow Chemical Company's treatment pond and Bullock Creek to the northwest, a segment of the river, and Dow property across the river, as well as Consumers Power property.
12 Activities on site will be related to the generation of power and process steam.

2.1.3.2 Agriculture Data

Distances by sector to the nearest residence/garden, milk cow, milk goat, and meat animal to 5 miles are presented in Table 2.1-10. Distances by sector from the north edge of the closest nuclear unit to the nearest outer fence and the nearest control boundary are presented in Table 2.1-11.

Agricultural statistics[5] for the counties within 50 miles of the Midland Plant indicate that approximately 74,000 head of beef cattle and approximately 154,000 head of hogs are sold per year. The annual meat production for beef cattle and hogs totals approximately 12,300,000 kg and 9,400,000 kg, respectively. Tables 2.1-12 and 2.1-13 contain the distribution of meat production by sectors to a distance of 50 miles from the Plant

There are approximately 109,000 milk cows[6] within 50 miles of the Midland Plant, which produce approximately 484,000,000 kg of milk per year. Table 2.1-14 contains the distribution of milk production by sectors to a distance of 50 miles from the Plant.

The area within 50 miles of the Plant produces approximately 52,000,000 kg of fresh market vegetables[7] on 11,000 acres. Table 2.1-15 contains the distribution of fresh market vegetable production by sectors to a distance of 50 miles from the Plant.

The major crops grown within 50 miles of the Plant are as follows[6]:

Type	Quantity (kg/yr)	Yield[a] (kg/m^2)
Corn		
Grain	1.07E+09	0.50
Silage	1.02E+09	2.69
Wheat	3.55E+08	0.26
Oats	7.80E+07	0.20
Barley	7.30E+06	0.26
Soybeans	1.49E+08	0.17
Dry Beans	1.40E+08	0.10
Sugar Beets	9.47E+08	3.81

(a) Average State Yield.

The grazing season is from about May 1 to November 1. In the last few years, there has been a shift from a daily green chop to a stored feeding program. Approximately 75% of the cattle are fed primarily stored hay and corn. It is believed that this trend will continue because it allows a better utilization
1 of land and a more efficient use of labor[8]. The pasture grass wet density is estimated to be 0.26 kg/m^2. Hay and grass silage production[5] yields 0.52 kg/m^2 from 278,000 acres.

Aerial photographs were used to locate the nearest residence in each of the 16 sectors. Consumers Power Company's Electrical Service Distribution maps were used to verify these residences. The nearest vegetable gardens were assumed to be located at the nearest residences. Field surveys (1977) of the area within 5 miles of the Midland Plant site consisted of driving all the public roads to physically locate all the milking cows, milking goats, beef cattle, hogs and also to verify the nearest residences.

The agricultural estimates are made by obtaining the most recently-published county data and distributing it to the proper sector. It is assumed that the agricultural data within each census unit is uniformly distributed.

2.1.3.3 Land Use in the Plant Vicinity

2.1.3.3.1 Land Use Within 5 Miles of Midland Plant

To determine the nature and extent of present and projected land use within 5 miles of the Midland Plant, land use information was obtained from Midland, Saginaw, and Bay Counties and the City of Midland. Most development in this area is concentrated around the City of Midland. The major industrial activities located there are The Dow Chemical Company and Dow Corning Corporation. Commercial and administrative facilities also exist in support

of the resident population of approximately 37,500 persons[9]. Outside of the city limits the land use is characterized primarily by agricultural and wooded areas, interspersed with rural residential areas. Figure 2.1-11 depicts the current patterns of land use and Figure 2.1-12, the plans for future development.

The agriculture within 5 miles of the Plant consists of varieties of grains, beans, and beets. In the portion of Williams Township (Bay County) included in the 5-mile radius and south of Route 10, the following crops are grown: corn, soybeans, navy beans, winter wheat and sugar beets. Livestock is also raised in that area. In the portion of Williams Township north of Route 10, there is some farming and cattle raising but most of the land use is nonfarm rural, ie, scattered rural residences with land holdings of 1 acre or more which are not farmed[10]. In the portion of Tittabawassee Township (Saginaw County) falling within the 5-mile radius, the principal crops grown are wheat, and several varieties of beans, including soybeans, navy beans and white shell beans[11]. There is also considerable nonfarm rural land use in that area.

The portions of Ingersoll and Mount Haley Townships that are within 5 miles of the Plant are primarily agricultural although there are nonfarm rural residences along the local roads. The principal crops grown in this area include soybeans, navy beans, wheat and corn[12]. There is considerably more residential development in the portion of Homer Township included in the 5-mile radius but areas of agriculture and open land also exist.

Current population projections for jurisdictions in the vicinity of the Midland Plant indicate that the high growth rates of recent years will not continue. In the decade from 1960 to 1970, population in Midland County, including that of the City of Midland, increased 23.9% to a total of 63,769

people[13]. The projected population for the year 1980 is 67,865, an increase of 6.4% for the 1970 to 1980 decade. For the year 1990, the projected population is 69,744, an increase of only 2.8% for the 10-year period beginning in 1980[14]. The portions of Bay and Saginaw Counties in the vicinity of the Midland Plant are experiencing similar growth patterns.

12

Consumers Power Company's Midland Plant power block occupies a previously unused area zoned "Industrial" by the Midland Township Planning Commission[16]. The power block is now within the city limits of the City of Midland. The area occupied by the cooling pond is zoned "Residential" but the Midland Township Zoning Board of Appeals issued a special use permit on March 18, 1970, permitting Consumers Power Company to use that area as a cooling pond. Special use permits are usually of short duration; however, in this case the permit is likely to be valid for the life of the Plant. This arrangement allows Midland Township to control the usage of that property. The special use permit allows only the construction of the cooling pond; changing the zoning to "Industrial" would permit other industrial uses on that land[17]. In accordance with the special use permit, Consumers Power Company will plant trees and shrubs outside the pond dike to screen it from the residential area near the western boundary and Gordonville Road along the south boundary (refer to Section 3.1.2.3).

The general intent of the zoning ordinances for the jurisdictions surrounding the Midland Plant (Midland, Bay, Saginaw Counties, and City of Midland) is to encourage maximum growth and development within existing urban areas prior to expanding to outlying rural areas. The approach is motivated by the philosophy that such development conserves energy, and expenses, as it is more

efficient to provide utilities and amenities in a compact area. The current zoning for the area within a 5-mile radius of the Midland Plant is depicted in Figure 2.1-14. No zoning maps are available for Mount Haley or Homer Townships; however, zoning information for these areas was obtained from local officials[18].

2.1.3.3.2 Coordination of Plant Activities With Adjacent Uses of Land and Water

The Midland Plant is well situated for access via road and rail systems. A rail bridge crossing the Tittabawassee River was built approximately 3/4 mile east-southeast of the reactor location to connect the Plant area to the Chesapeake and Ohio Railroad System, across the river on Dow Chemical Company property. The C & O line runs northwest-southeast through Midland and follows the north shore of the Tittabawassee River to Saginaw.

The railroad bridge was constructed so as not to interfere with floodwater flow. All spoil originating on site was used in the construction of the dikes or as fill for the building site or the low areas of the cooling pond. An existing secondary road was improved in connection with construction of the railroad bridge.

The Tittabawassee River was widened, with approval by the US Army Corps of Engineers, to compensate for loss of floodplain resulting from Plant
12 construction. As shown in Figure 2.1-10, two existing agricultural drains, which extended across the area of the cooling pond, were relocated to the Plant site boundaries.

Modifications of the existing road system have been made to improve access to the Plant and to allow the increased Plant traffic to occur without disrupting normal traffic.

As previously mentioned in Section 2.1.3.1, an access road, which extends from Poseyville Road southeasterly to Miller Road at the Plant boundary, was built to minimize disruption of normal traffic during the construction phase. Consumers Power Company has designated it as the permanent and primary access road to the Plant. Since the road is located on property owned by the utility, it would be the approach route which would have the least impact on surrounding areas. Poseyville Road, which connects the Plant to US Route 10 approximately 2 miles north, has been widened to four lanes to the temporary access road by the Midland County Road Commission. US Route 10, a four-lane limited access highway, extends east to Bay City and northwest to US Route 27, a north-south limited access highway located in the middle of the state. Access to areas south and east of the Plant has been improved recently by the extension of Gordonville Road to the east. This was made possible by the construction of a new bridge, which crosses the Tittabawassee River near the southeast corner of the Plant site.

Although the Tittabawassee River is considered a navigable river by the US Army Corps of Engineers, the present condition of the river prohibits barge traffic in the vicinity of the Midland Plant. According to a recent publication of the US Department of Commerce, the Tittabawassee River is only navigable for small boats and, in places, navigation is obstructed by sunken logs and snags[19].

The Plant will use the cooling pond as a storage impoundment for closed cycle condenser cooling. Water will be withdrawn from the Tittabawassee River

12 during periods of high flow to replenish losses due to seepage, evaporation, and blowdown. The Plant will also use Lake Huron water, received via the City of Midland water supply system, for drinking water and additional requirements other than cooling water. The water is pumped from Lake Huron and treated as required for these purposes. Treatment facilities of the City of Midland will be expanded over several years to meet the needs of the
2 Midland Plant. The water from two existing onsite wells is presently used for
1 fire fighting purposes and to meet construction needs; these wells will be sealed prior to the completion of construction.

An existing pipeline on the railroad bridge will be used to transport water from the City to the Midland Plant. Process steam will be transported from the Midland Plant to Dow Chemical Company over the pipe bridge currently used by the Dow wastewater treatment facilities. The sale of process steam to Dow will result in no immediate net water use change due to the Midland Plant since Dow presently provides this steam from their own fossil-fueled plants.

Consumers Power Company foresees no future expansion that would warrant the reservation of additional rights-of-way. The effects of the thermal loading and nonradioactive chemical discharges on aquatic and terrestrial life in and near the pond and river are described elsewhere in this report (refer to Section 5.1).

2.1.3.4 Water Use

12 The Midland Plant is located in an area that has been the focus of several comprehensive water resource studies. Recent studies have been conducted by
1 the Great Lakes Basin Commission (1975)[33], the East Central Michigan
12 Planning Development Region (1976)[34], the Michigan Water Resources

12 Commission (1974)[35] and the International Joint Commission[35a]. Much of
1 the material presented in this Section came from the above reports. Together they provide a description and assessment of ground and surface water uses and water quality conditions in the vicinity of the Midland Nuclear Plant. A summary of each report is presented in Section 6.3. The study areas of each report coincide quite closely with the 50-mile radius of the Plant (see Figure
12 2.1-15). These reports may be referred to for more detailed information not specifically covered in this section.

The State of Michigan has defined certain designated uses for the waters of the State. These designated uses for the Tittabawassee River are discussed in
12 Section 5.1.1.

2.1.3.4.1 <u>Surface Water Uses</u>

The Midland Plant is located on the south bank of the Tittabawassee River within the Tittabawassee River Basin (see Figure 2.1-16). The topography in the eastern and southeastern portion of the basin does not have a pronounced relief and is characterized by some lakes and marsh areas. Low-lying areas are drained by canals and ditches and five major tributaries: the Tobacco, Salt, Chippewa, Pine and Tittabawassee Rivers. The four smaller rivers merge with the Tittabawassee River upstream of the Plant. The Pine and Chippewa Rivers join the Tittabawassee River approximately 2-1/2 miles northwest of the Midland Plant site. Approximately 20 miles downstream from the Plant, the Tittabawassee River merges with the Saginaw River, which empties into Saginaw Bay. There are four dams with reservoirs on the Tittabawassee River proper upstream of Midland. All are used for the generation of hydroelectric power

(refer to Table 2.1-16). The operation of these dams causes daily river level fluctuations up to 18 inches at the Plant.

Intakes

Saginaw Bay is the largest and most important surface water body in the 50-mile radius of the Midland Plant. Lakes and reservoirs having a surface area of 100 acres or more and lying within the 50-mile radius are listed in Table 2.1-16.

The Bay serves as a source of water for 44 separate water supply and/or
distribution systems located in Arenac, Bay, Iosco, Saginaw and Tuscola
1 Counties[33]. Over 300,000 people receive water from five raw water intakes
in the Bay which are operated by the Saginaw-Midland Water Supply Company, the
City of Bay City, the US Gypsum Company, the City of Pinconning, and the City
1 of East Tawas[34]. The general location of these and other intakes and a
brief description of the treatment afforded the raw water are shown in Table
2.1-17 and Figure 2.1-17.

1 The Great Lakes Basin Framework Study[33] states that "water use by
manufacturers in Planning Subarea 3.2 is almost five times as great as the
domestic and commercial use supplied by municipal systems." Planning
Subarea 3.2 includes Clare, Gladwin, Isabella, Midland, Bay, Gratiot, Saginaw,
Huron, Tuscola, Lapeer and Genesee Counties (see Figure 2.1-15). Much of the
water used for industrial purposes is accounted for by withdrawals of
approximately 300 mgd from the Tittabawassee River by the chemical industrial
12 complex at Midland[34] which also utilizes water obtained from Lake Huron[33].

Discharges

Point source discharges to surface waters in the vicinity of the Plant are shown in Figure 2.1-18. The Michigan Department of Natural Resources' (DNR) numbers assigned according to county for the ECMPDR Study Area were obtained from the MDNR's Listing of Permitted Dischargers. Only significant point dischargers were plotted on Figure 2.1-18, and the type of discharge is described in the legend.

Significant municipal and industrial dischargers to the Tittabawassee and
1 Saginaw Rivers are identified by segment[35] in Figures 2.1-19, 2.1-20 and 2.1-21.

Significant Industrial Dischargers

The only significant industrial discharger in Segment 10 is The Dow Chemical Company, located in Midland (see Figure 2.1-19).

The Midland plant of Dow Chemical is one of the largest chemical complexes in the world. The plant has a 50 mgd biological waste treatment system for treating organic wastes; trickling filter and activated sludge units for phenolic wastes that are pretreated in equalization ponds; and deep well injection for concentrated waste.

Other treatment processes emplo[illegible] include clarification and screening; sludge conditioning; centrifugation; neutralization; disinfection; and a tertiary treatment lagoon.

12

GMC, Chevrolet Metal Casting, Saginaw -- The Chevrolet Metal Casting Plants of Saginaw produce grey and nodular iron castings to be used in the automotive industry. The basic processes involved are forming the sand molds and cores, removal of cores, filling with molten iron, curing and removing. The wastewaters involved in the above processes are principally 25% sluice water used in removal of core sand, 70% dust collector water from the air pollution control devices, and process cooling water and condensate.

The majority of the wastewater generated is discharged into an earthen settling pond, located at Chevrolet Nodular Iron, for solids removal. This pond effluent is discharged into the Saginaw River. The remainder of the process wastewater is generated by Chevrolet Grey Iron and is discharged into a similar settling pond located at Grey Iron. This wastewater is from the sluicing of uncontaminated core sand. This settled sand is reused by Grey Iron.

Combined waste flows generally vary from 24 to 36 mgd during plant operation, the majority of flow being from the nodular iron outfall.

Michigan Sugar Company, Carrollton -- The Michigan Sugar Company campaign generally lasts from September to March, during which period the plants operate 24 hours per day, 7 days a week. The principal product is dry, granular sugar with by-products of molasses and dried beet pulp.

The extraction of sugar from beets is done in five steps consisting of (1) diffusion, (2) purification, (3) concentration, (4) crystallization, and (5) separation. The extraction process is somewhat complex and is essentially a closed cycle operation with little wastewater being generated. Prior to the extraction process, however, the beets are transported in a water flume and

washed. The flume water and wash system are major sources of wastewater. The concentration operation involves evaporation and condensation with the condensate water being discharged as wastewater. Other sources of wastewater are the lime-cake and ash-cinder transport water.

Condenser water is discharged directly to the Saginaw River. Process wastewater from the beet washing and fluming is aerated in a 1-acre pond and then either reused or discharged to 7 acres of holding ponds. Lime wastewater also goes through the 1-acre aeration pond to the holding ponds. An additional 8 acres of holding ponds are not used but are available, if needed. The total holding capacity of the system is about 50 days at average plant flows.

Monitor Sugar Company, Bay City -- Monitor Sugar Company processes sugar beets into sugar, molasses, and dried beet pulp. The sugar is sold for domestic consumption, while the molasses and pulp are sold as livestock feed. Processing is seasonal, coinciding with sugar beet production in the fall and winter.

The wastewater produced in manufacturing these items is treated by Monitor Sugar Company before discharging to the Columbia Drain. The treatment imposed is screening and chemical coagulation, followed by lagoon aeration. The wastewater entering this treatment system comes from the fluming and washing of beets. The flume water is a mixture of river water (from the Saginaw River) and recycled water from the primary treatment system. The company uses filtered river water to wash the beets. The sand filter backwash is discharged to the primary system. Flow rates average approximately 4 to 5 mgd.

Another source of wastewater is the cooling water from process evaporators and vacuum pans. This is discharged untreated to the Columbia Drain. Flows are approximately 3 mgd.

<u>Consumers Power Company, Essexville</u> -- Consumers Power Company operates the
Karn-Weadock Electric generating complex located at the mouth of the Saginaw
River. The Karn and Weadock Plants pump noncontact cooling water, service
water and cooling tower makeup water from the Saginaw River and discharge
12 their effluents into Saginaw Bay through a common flume. The average design
ΔT for Weadock is 11.7°F and 14.3°F for Karn. They use approximately 500,000
gpm of water when running at plant capacity.

The Karn Plant has two coal-fired generating units, each rated at 265 MWe and
1 two oil-fired units having a combined rating of 1,237 MWe. The coal-fired
units have once-through cooling and the oil-fired units have cooling towers.

12 The Weadock Plant has the capacity of operating eight generating units: two
rated at 35 megawatts, two rated at 50 megawatts, two rated at 66 megawatts
and two rated at 156 megawatts. The six smaller units are fueled by oil and
the two larger units are coal-fired. Beginning January 1981, the status of
12 the six smaller units is economy reserve with limited protected hours of
operation through 1990. All units have once-through cooling.

<u>Significant Municipal Dischargers</u>

The City of Midland Wastewater Treatment Plant is the only significant
municipal discharger in Segment 10. Narrative on this facility can be found
1 in Section VI of the Great Lakes Basin Framework Study[33].

There are no significant municipal or industrial dischargers in Segment 50 (see Figure 2.1-20).

There are three major and three minor municipal wastewater treatment plants which use the surface waters of the Saginaw River main branch, Segment 27 (see Figure 2.1-21). The type of treatment afforded by wastewater treatment plants on the Saginaw River and their amounts of discharge are listed in Table 2.1-18. There are five major industrial wastewater dischargers which utilize the Saginaw River for waste assimilation.

Significant municipal dischargers to Segment 27 are the Bay City, Saginaw, and Zilwaukee Wastewater Treatment Plants.

2.1.3.4.2 Groundwater Uses

General Terrain Characteristics

The Midland Plant is situated within the Tittabawassee River Basin (see Figure 2.1-16) on a glacial lake plain. This portion of the basin is characterized by relatively slight topographic relief, with some lakes and marshes, and generally a poorly defined drainage pattern. The elevation of the Plant site is 634 feet, with surrounding areas ranging from 600 to 625 feet, down to 596 feet in the Tittabawassee River bottom.

1 Groundwater Occurrence[37]

The Plant is located in an area where glacial till and lake deposits of sand,
2 silt and clay overlie the Pennsylvania Saginaw Formation. The glacial
deposits range from 150 to 350 feet thick at the Plant site and are relatively widespread. The Saginaw Formation is nearly flat-lying and consists of shales, sandstones and siltstones.

The presence of a thick impermeable clay layer has produced two hydrologic conditions at the Plant site:

a. A perched water table in the sand above the clay; and

b. An artesian aquifer in the sand and gravel underlying the clay.

2| The perched water table is in the upper brown sand which ranges up to 65 feet thick as indicated in sample boring data. The major source of this near-ground water is rainfall which seeps through the overburden, with a 1% hydraulic gradient toward the river. The quantity of water in these surface sands is limited and they are not a source of domestic supply in the area.

A survey of the domestic wells in the vicinity of the Plant reveals that water is drawn from the artesian aquifer confined below the thick, impermeable clay layer.

<u>Groundwater Use Within 50 Miles</u>

As evidenced by the information contained in Table 2.1-19, groundwater is a minor source of municipal water downstream of the Plant but a major source within the 50-mile radius. At present, all municipalities downstream of the Plant obtain their drinking water from artesian wells or from Saginaw Bay (Lake Huron). Groundwater is a source of recharge to the Tittabawassee
1| River[37]. The lower drift zone or artesian aquifer in the Midland area may be recharged from exposed moraines east of the Midland area. The river, however, does not contribute to this aquifer, since the piezometric head of the aquifer is higher than the water level of the river, again causing a hydraulic gradient from the aquifer to the river. Therefore, water taken from the river and consumed by evaporation from the pond does not affect recharging of the groundwater reservoirs downstream of the Plant. Even if the river did

recharge the deep aquifer used for domestic wells, the small percentage of river flow removed through Plant operation would not affect the recharging
1 | capability[37].

1 | Wells on the property have been sealed and grouted[37]. The cooling pond site is underlain by soil strata (glacial till) of low permeability (between 1 x 10^{-8} and 1 x 10^{-9} cm/s) with occasional pockets of more pervious sand (surficial silts and sands) compared to the uppermost soils -- generally to a depth less than 15 feet. A cutoff wall of suitable impervious materials and/or a bentonite slurry trench extending to the impervious till has been emplaced within the dikes. Estimated seepage losses are considered minimal -- not to exceed 1-2 cfs. For design purposes, a seepage loss of 4 cfs or approximately 800 acre-feet was assumed for the design drought. The impervious layer prevents downward percolation from the cooling pond into the deep artesian aquifer. Also, the migration of any contamination through the impervious clay would be extremely small because of the ion-exchange capacity of the clay. In addition, all domestic wells in the area are located up-
1 | gradient from the Plant site[37]. There should be no contamination of groundwater supplies, and consequently no contamination of any domestic water supplies which obtain their water from the artesian aquifer underlying the thick impermeable layer of clay.

Sources of water for supply and distribution systems within the 50-mile radius are indicated in Table 2.1-19. ECMPDR identifies 52 water supply and/or distribution systems within their study area. These systems serve approximately 94,000 people who obtain their water from aquifers. In addition to the portion of the populace served by established distribution systems with

groundwater supplies, nearly 296,000 people tap the groundwater resource for their private supplies.

Industrial water supplies are obtained from groundwater sources through both municipal systems and private wells. Well water supplies are not expected to be an important source for new manufacturing supplies because of limited yields of aquifers and the relatively poor groundwater quality.

Irrigation water is used for frost protection, supplementing rainfall, field cooling, seed bed preparation and fertilizer application. Michigan irrigator
1 use averages about 5.1 inches of water annually[38]. Water is also used to irrigate golf courses and for commercial purposes. Figure 2.1-22 is a map of ground and surface water sources of irrigation water within the ECMPDR study region. Table 2.1-20 includes a breakdown of the number of acres irrigated and the number of groundwater sources of irrigation water arranged by major drainage basin. Although the data are relatively old (1967), it is the most recent available and serves to indicate the areas in which irrigation is most heavily used.

There is no known point downstream where the Tittabawassee River is used as a source of domestic water, for irrigation or for fish farming activities.

2.1.3.5 Commercial and Recreational Fish Catch and Hunter Harvest

2.1.3.5.1 Surface Waters - Recreational

The lakes and streams within the 50-mile radius of the Plant provide a valuable recreational resource. The surface waters of this area are utilized for boating, swimming, fishing, hunting and picnicking recreational activities. Power boating and sailing are extremely popular on Saginaw Bay,

and canoeing is popular on many streams of the area. Marine harbors on the
Saginaw River and Bay are used extensively. There are 24 public beaches on
1 the shores of Saginaw Bay and Lake Huron[34].

The surface waters of this region support a diverse year-round sport fishery.
The Bay, streams, inland lakes and impoundments provide good fishing for
panfish, bass, northern pike and walleye. However, contiguous waters that may
12 be influenced by Plant operation include only the Tittabawassee and Saginaw
Rivers below the Plant, and Saginaw Bay. The Tittabawassee River is
classified as supporting a warmwater fishery, but the section below the Plant
has limited fishery value at present due to a Michigan Department of Public
Health Advisory against eating fishes from the Tittabawassee Rivershed[38a].
12 Fish species composition and abundance are described in Section 2.2.2.1.
Additionally, the Tittabawassee River has limited recreational value due to
its designation as a partial body contact recreational area (Section 1.1).

Results of the MDNR Sport Fishing Surveys[38b] of 1972, 1973 and 1975 for Midland and Bay Counties and of 1975 for Saginaw County are shown in Table 2.1-21. These estimated catches are county-wide and do not necessarily reflect the catches in contiguous waters.

Saginaw Bay is the center of fishing activity. Yellow perch is the prime
recreational species of the Bay. The Bay is also productive of northern pike,
catfish, bass, walleye, and carp. Boat and shore fishing are very popular
along the Bay shoreline. An estimated 5,693,000 fishing days were spent in
the East Central Michigan Study area in 1972 with a success ratio of 1.82
pounds per day, and an intensity of use ratio of 23 days per acre of water
1 surface[35]. MDNR Sport Fishing Survey results of catches on Saginaw Bay and

selected tributary streams for 1971, 1972, 1973 and 1975 are presented in Table 2.1-22.

Recently coho and chinook salmon have become important due to an extensive stocking effort in the Au Gres, Rifle, Flint and Cass Rivers and at Caseville. Table 2.1-23 lists salmonid plantings in the area of the Plant for 1975, 1976
1 and 1977[39].

2.1.3.5.2 Commercial Fish Catches

Traditionally, Saginaw Bay has been a prominent commercial and recreational fishing resource. Over 90 species have been recorded in the Bay including lake herring (Coregonus artedi), rainbow smelt (Osmerus mordax), chubs (Coregonus hoyi), white sucker (Catostomus commersoni), channel catfish (Ictalurus punctatus), yellow perch (Perca flavescens), walleye (Stizostedion vitreum), whitefish (Coregonus clupeaformis), lake trout (Salvelinus namaycush), bullheads (Ictalurus sp.), rock bass (Ambloplites rupestris), carp (Cyprinus carpio), alewife (Alosa pseudoharengus), smallmouth bass (Micropterus dolomieui), northern pike (Esox lucius), rainbow trout (Salmo gairdneri), coho salmon (Oncorhynchus kisutch), chinook salmon (Oncorhynchus tshawytscha), and numerous forage and noncommercial fishes[40].

The fisheries resources of Saginaw Bay have been studied extensively and these studies generally conclude that the fisheries resources of the Bay have been severely altered in the last century and that the commercial fishing industry there is endangered. Freedman[40] provides an extensive historical and present day account of the changes and status of the commercial fishing industry of Saginaw Bay.

Commercial fishing became established in Saginaw Bay in the middle of the 1800's and peaked in 1902 at 14,182,000 pounds of production. Commercial fishing regulations, techniques, effort, fish species composition and market have changed considerably since the establishment of the Saginaw Bay fishery. As a result, the commercial catch from 1974 to 1978 averaged only 1,570,000
12 pounds per year (Table 2.1-24). Carp, catfish, suckers and yellow perch are presently the most important commercial species. The commercial fishery in Saginaw Bay is currently a minor industry. However, the Bay still has the highest fishery productivity in the entire Lake Huron system.

2.1.3.5.3 Hunter Harvest

Table 2.1-25 shows the annual average hunter harvest within a 50-mile radius of the Midland Plant site. The annual average harvest figures represent the six-year period from 1970 through 1975[41].

No data are available to estimate the amount of game that is consumed locally. However, MDNR personnel[41] estimate that 80% of the game harvested is taken by residents of that area. Hence, we can broadly assume that 80% of the game harvested is consumed locally.

TABLE 2.1-20
IRRIGATION IN THE ECMPDR STUDY AREA[(a)]

Area	Type of Irrigation	Number of Systems	Number of Acres	Number of Groundwater Sources	Number of Surface Water Sources
Tittabawassee River Basin	Agricultural	20	2,333	3	17
	Commercial	2	72		2
	Golf	15	485	4	11
Cass River Basin	Agricultural	5	161	2	3
	Commercial	2	327		2
	Golf	4	131	2	2
Rifle River Basin	Agricultural	3	87	3	
	Commercial				
	Golf	1	30		1
Bay County	Agricultural	27	2,126	7	20
	Commercial				
	Golf				
Au Gres River Basin	Agricultural	1	40	1	
	Commercial	1	80		1
	Golf				
Saginaw River Basin	Agricultural	3	19		3
	Commercial	2	3		2
	Golf	2	18		2
Shiawassee River Basin	Agricultural	20	616	9	11
	Commercial	6		2	4
	Golf	13		7	6
Huron County	Agricultural				
	Commercial				
	Golf	6	141	4	2
Black River Basin	Agricultural	8	583	2	6
	Commercial	9	1,567	4	5
	Golf	5	260		5
Kawkawlin River Basin	Agricultural				
	Commercial				
	Golf	2	14	1	1
	TOTALS	152	9,372	51	106

Note: Data incomplete for Gratiot, Clare, Roscommon, Ogemaw and Iosco Counties.

1 (a) ECMPDR[(34)].

TABLE 2.1-21

1 MICHIGAN SPORT FISHING SURVEY ESTIMATES FOR BAY, MIDLAND AND SAGINAW COUNTIES[(b)]
(NUMBER OF FISH)

	1972		1973		1975		
	Bay	Midland	Bay	Midland	Bay	Midland	Saginaw
Yellow Perch	1,839,740	17,850	2,309,850	55,980	4,352,170	60,520	25,500
Walleye/Sauger	0	0	2,700	0	0	170	0
Bass	30,600	13,600	15,660	19,170	20,060	14,960	2,210
Panfish[(a)]	106,420	242,380	87,120	95,760	0	0	0
Northern Pike/Muskie	8,330	4,080	10,440	3,240	8,500	6,120	6,630
Suckers	4,420	13,600	19,800	5,040	20,910	6,970	33,490
Smelt	109,990	0	0	0	0	0	0
Lake Trout	0	0	90	0	0	0	0
Rainbow/Steelhead Trout	0	0	0	90	510	170	170
Brown Trout	0	0	180	0	0	170	0
Brook Trout	0	0	0	0	8,500	340	0
Coho Salmon	0	0	0	0	850	0	3,230
Chinook Salmon	0	0	0	0	850	0	1,700
Crappie & White Bass	0	0	49,950	266,130	51,000	372,470	44,370
Catfish & Bullhead	0	0	261,180	31,050	188,190	63,750	19,422
Whitefish/Cisco	0	0	0	0	1,700	0	0
Rock Bass	0	0	0	0	1,020	24,310	2,968
Sunfish/Bluegill	0	0	0	0	172,380	132,600	6,970
Other	49,810	24,140	91,350	3,780	18,190	4,930	10,030
Angler Days	170,170	67,830	199,800	73,530	295,120	95,540	49,130

(a) The category panfish includes Crappie & White Bass, Rock Bass and Sunfish/Bluegill in 1972, Rock Bass and Sunfish/Bluegill in 1973; however, these categories were reported separately in 1975.

12 (b) MDNR[(388)].

TABLE 2.1-22

SPORT FISH CATCHES WITHIN THE 50-MILE RADIUS OF THE MIDLAND PLANT[a]

Species	Saginaw Bay 1971	Saginaw Bay 1972	Saginaw Bay 1973	Saginaw Bay 1975	Au Gres River/Whitney Drain 1971	Au Gres River/Whitney Drain 1972	Au Gres River/Whitney Drain 1973	Au Gres River/Whitney Drain 1975
Yellow Perch	2,360,200	5,774,050	6,185,340	10,962,790	12,580	25,160		
Walleye/Sauger	1,460	680	9,090	510				
Bass		65,790	39,240	94,690				
Northern Pike/Muskie	29,060	19,380	21,060	36,210	23,100			
Suckers		28,900	22,500	64,430		2,040		
Lake Trout	160		360	1,020				
Rainbow/Steelhead	100	170	270	3,230	10,880	12,410	23,130	14,960
Brown Trout	320		450	5,440	2,360	1,190	810	170
Coho Salmon	100			9,860			360	7,480
Chinook Salmon	160			15,810		170	180	15,300
Crappie/White Bass			62,550	145,860				
Bullhead/Catfish			384,210	523,430				
Whitefish/Cisco				3,220				
Rock Bass				1,700				
Sunfish/Bluegill		266,730	244,260	559,470		2,550		
Other		94,350	297,450	33,150		5,100	766,170	510
Angler Days	358,360	527,170	506,340	863,600	27,620	46,240	83,340	53,040
Fishermen	48,920	73,610	89,370		5,980	14,450	34,110	

Species	Cass River 1971	Cass River 1972	Cass River 1973	Cass River 1975	Rifle River 1971	Rifle River 1972	Rifle River 1973	Rifle River 1975
Yellow Perch		850						
Walleye/Sauger								
Bass		1,870						
Northern Pike/Muskie		1,700			100			
Suckers		39,270				58,990		
Lake Trout								
Rainbow/Steelhead		170		510	3,300	6,290	2,340	1,020
Brown Trout					2,060	3,740	8,190	
Coho Salmon	7,520	4,930	18,630	2,210			180	170
Chinook Salmon		340	1,620	2,040			180	170
Crappie/White Bass								
Bullhead/Catfish								
Whitefish/Cisco								
Rock Bass								
Sunfish/Bluegill								
Other		2,040		1,530			18,360	
Angler Days	5,880	18,530	14,850	7,650	24,420	20,740	13,770	5,270
Fishermen	840	3,910	2,970		5,780	5,780	3,780	

12 (a) MDNR[32c].

TABLE 2.1-23

1 SALMONID PLANTINGS WITHIN 50 MILES OF THE MIDLAND PLANT, 1975-1977[a]

Stream	Rainbow Trout/ Steelhead	Brown Trout	Lake Trout	Coho Salmon	Chinook Salmon	Total
Whitney Drain						
1975	5,040					5,040
1976	16,100	30,144				46,244
1977	10,000					10,000
Au Gres River						
1975					100,447	100,447
1976					100,970	100,970
1977					75,000	75,000
Rifle River						
1975	15,000					15,000
1976	10,440					10,440
1977	10,000					10,000
Cass River						
1975				151,410		151,410
1976				100,000	100,496	200,496
1977				225,000	100,000	325,000
Tawas						
1975	5,000	10,000	78,000	100,892		193,892
1976	10,000	40,007	100,000	80,800		230,807
1977						
Caseville						
1975	5,076	5,025				10,101
1976	10,000	10,000				20,000
1977	5,000	10,000				15,000
Port Austin						
1975		10,000	100,000			110,000
1976						
1977						
Grindstone						
1976		40,000	100,000			140,000
Flint						
1976					125,590	125,590
1977					125,000	125,000

1 (a) MDNR, 1977 [39].

TABLE 2.1-24

COMMERCIAL CATCH RECORDS (lb)

District MH-4 - Saginaw Bay

Species	1970[a]	1971[a]	1972[a]	1973[a]	1974[a]	1975[a]	1976[b]	1977[b]	1978[b]
Alewives	----	----	38	----	190	20	----	245	----
Bowfin	221	235	114	10	744	2,331	884	2,076	390
Buffalofish	55	----	----	227	8,365	----	----	----	2,620
Bullheads	56,383	44,742	57,425	39,096	42,872	39,474	29,968	20,572	5,352
Burbot	48	54	----	----	----	----	----	----	----
Carp	1,223,999	1,387,513	888,296	765,952	684,062	629,071	716,004	787,213	686,823
Catfish	225,618	365,050	253,560	325,427	272,048	282,815	378,885	400,052	433,482
Crappie	9,701	48,862	46,437	56,140	61,941	85,587	55,575	26,949	19,150
Gizzard Shad	----	385	----	----	35	439	5,402	3,213	17,347
12 Quillback	21,028	21,241	9,102	9,892	11,776	16,468	7,492	8,473	6,802
Rock Bass	561	911	457	----	227	----	----	4	----
Sheepshead	12,077	8,881	6,386	103,735	18,993	15,932	13,413	8,233	12,809
Smelt	----	660	20	20,000	4,000	----	16,000	----	----
Suckers	137,704	132,351	90,579	144,724	110,563	108,623	124,803	98,407	132,005
White Bass	155	605	363	193	1,239	117	540	112	844
Whitefish	4,111	5,002	26,421	15,029	16,036	26,994	28,532	41,764	40,339
Menominee	----	----	154	42	75	167	15	7,807	20,076
Yellow Perch	535,548	597,276	326,[illegible]48	309,018	229,158	268,959	322,055	255,515	164,357
Yellow Pike	8	----	----	----	----	----	----	----	----
TOTAL	2,227,217	2,613,768	1,706,100	1,789,485	1,462,324	1,476,997	1,699,578	1,659,635	1,542,405

(a) USF & WS, 1977[42].
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2.2 ECOLOGY

2.2.1 Terrestrial Ecology

The original survey of terrestrial ecological features of the Midland Plant site was conducted by Michigan State University in 1971[1]. At the time of the survey, most of the original vegetation had been removed from the site in preparation for construction. Aside from a few scattered pockets of original vegetation on the edges of the construction area and on the Tittabawassee River and Bullock Creek flood plains, all that remained of the preconstruction vegetation was a 120-acre (48.6 ha) parcel which had not yet been acquired.

In order to assess the impact that construction activities had on the preconstruction flora and fauna, aerial photographs were used to estimate the nature and extent of the prior vegetative cover types. The species and
12 species densities of associated faunal elements were estimated on the basis of their occurrence in similar cover types near the site. These data on preconstruction vegetation and faunal numbers and diversity were then compared with vegetation and faunal values at the time of the survey.

Prior to the purchase of the site for the Midland Plant, the area land use/cover types consisted of rural homes and farmsteads, cropland, pastures, old fields in various stages of succession, and areas of mature and immature forest. At the time of the survey, cleared areas supported an early seral stage forb community.

Vegetation on the Midland Plant site may be subject to physiological stresses due to high levels of salt from The Dow Chemical Company Plant and associated brine ponds immediately north of the Midland Plant. This condition, which

predates construction, has resulted in concentrations of soluble salts of about 100 ppm in soils on the Plant site[2]. The same study showed the concentration of suspended particulates to be about 100 $\mu g/m^3$, of which about 10% is salt. The combination of soil dust and suspended particulate salts can result in a deposition rate of 2.5×10^{-5} mg cm^{-2} day^{-1}. Salt levels on some areas of the Plant site are thus comparable to those of a marine environment. No studies have been conducted to determine what impact these salt levels may have on the local environment.

Prior to construction, the Plant site contained the basic habitat components for a variety of wildlife and probably supported moderate population densities of the more common species. Preconstruction clearing rendered the Plant site fairly unproductive for wildlife except for several species of seed-eating and
12 insect-eating birds[1]. Construction of the Plant and associated facilities has removed the vegetation recorded during the survey except along the flood plains of the Tittabawasee River and Bullock Creek.

The bulk of the terrestrial ecosystem on the Plant site has been replaced by the 880-acre cooling pond. Preoperational monitoring programs on this ecosystem are being conducted by the Applicant. Operational monitoring programs are also planned. (See Section 6.1, 6.2 and 6.2a.)

An ecological survey of the area to be impacted by the construction, operation and maintenance of the Midland Plant's transmission lines was completed in September of 1979. A list of "important species" appearing on or near the transmission line is presented in Table 2.2-1a. The list includes "important" avifauna associated with the cooling pond. These data are derived from the final report on that survey, dated November 10, 1979[2a].

2.2.2 Aquatic Ecology

12 Historical data, such as the studies conducted by The Dow Chemical Company[5,6] and the Michigan Water Resources Commission (MWRC)[7] provide an adequate background on the Tittabawassee River aquatic ecology during 1971-1974 at the Midland Plant site. During 1977 and 1978, Consumers Power Company contracted the Department of Biology of Central Michigan University to develop strategies for future aquatic monitoring. During 1979, Lawler, Matusky and Skelly Engineers were contracted to conduct a preoperational aquatic monitoring program near the Midland Plant site. These studies are summarized in the following discussions.

12 2.2.2.1 Historical Aquatic Ecology Data

Collections during the early 1970s, when compared to Consumers Power Company's pilot (Section 2.2.2.2) and preoperational (Section 2.2.2.3) monitoring collections indicated that the aquatic environment of the Tittabawassee River is undergoing noticable improvement.

2.2.2.1.1 Fishery

Table 2.2-1 lists the fish species identified during the 1971 through 1974 studies[5,6,7] at various locations in the vicinity of the Midland Plant. In these three studies, electroshocking was the principal technique used; however, Batchelder and Alexander (1974)[6] complemented the electroshocking with fyke netting and a tag and recapture technique.

12

Distribution

During the early 1970s, the Tittabawassee River upstream of the City of
12 Midland had a healthy fish population composed of game fish, coarse fish and forage fish. These fish were almost entirely warmwater species. The most important game species were smallmouth bass, yellow perch, crappie, rock bass, northern pike and channel catfish. Three salmonids were collected during the 1973 study[6] including a single fish at Emerson Park and two fish at Dow Dam Station.

The MWRC (1972)[7] and Zillich (1973)[5] studies showed that the fish populations were low in the Tittabawassee River segment from the City of Midland downstream to its confluence with the Saginaw River, a distance of approximately 20 miles (32.2 km). Game fish were almost absent and the majority of the species caught were coarse and forage fish. However, below the Dow Dam, the MWRC study[7] identified eight game fish species during a fish kill on July 27, 1971; including crappie, black bullhead, pumpkinseed, smallmouth bass, northern pike, rock bass, white bass and bluegill.

Batchelder and Alexander[6], two years later, reported the presence of game fish in the fyke nets located in the segment of Tittabawassee River downstream from the City of Midland during their 1973 collections. Their results indicated that electroshocking was not efficient in the collection of game fish, since the number of game fish found could be related to the length of
12 time of shocking and the varying difficulty in trapping fish. The electroshocking resulted in approximately 60% carp and 16% crappie, whereas netting resulted in 51% crappie, 18% sunfish and 15% bullhead. In either case, game fish were present in the samplings. Improvement since 1971 was

12 indicated by the reappearance of some game fish such as northern pike, sunfish, crappie and smallmouth bass.

In 1973[6] the combined catch of electrofishing and fyke netting in the Tittabawassee River upstream of the City of Midland, downstream of the Dow Dam at Smith's Crossing, at Freeland and at Saginaw Township Park yielded 59%, 87%, 60%, 49%, and 27% game fish, respectively. The biological degradation of the waters at Smith's Crossing, Freeland, and Saginaw Township Park, although improving, was attributed to the effluents from the Midland wastewater treatment plant and discharges from The Dow Chemical Company Complex[8].

The tag and recapture portion of the study[6] did not conclusively demonstrate
12 whether the fish represented resident or transient populations. Communication[9] with Dow Chemical Company biologists disclosed that the majority of the river fish are apparently transient.

Importance of Local Species

12 Commercial fishing is not a major economic activity in the study area. The commercial fishery statistics in this area are given in Section 2.1.3.5.2.

In 1972, the MWRC[7] reported that heavy metal and toxic organic materials in fish captured in the Tittabawassee River were below the limits set by the US Food and Drug Administration. DDT levels were greater in fish taken in the vicinity of the City of Midland, yet no critical problems of pesticide contamination in fish appeared. On the other hand, taint tests showed that the edibility of fish for distances up to 16 miles (25.8 km) below the Midland Plant site was inferior. Future compliance with the water quality management planning by the State of Michigan should insure the continued recovery of this

river and reestablishment of game fish populations. This is expected to initiate sport fishery activities in the area.

None of the fish collected in the Tittabawassee River are classified as rare or endangered species.

Spawning Seasons and Feeding Habits

12 Fishes found in the vicinity of the Midland Plant are warmwater species,
except for salmonids that were planted and are not discussed in terms of
spawning requirements. The existence and establishment of warmwater fish
populations in the river are dependent on water conditions. Spawning
activities can be anticipated, particularly as water quality continues to
12 improve. The principal game fish species are yellow perch, crappie, northern
pike, bass and channel catfish. Carp and gizzard shad represent the major
coarse and forage species. The descriptions of spawning activities and
feeding habits for these species are derived from Scott and Crossman[10].

The gizzard shad (Dorosoma cepedianum) has demersal and adhesive eggs which are deposited in spring or early summer. These eggs may also drift with the current and adhere to any object they contact. Eggs usually hatch in 95 hours at 16.7°C (62°F) or about 36 hours at 26.7°C (80°F). The gizzard shad young begin feeding on minute zooplankton, especially protozoans and entomostracans. Young gizzard shad up to 22 mm (7/8 in) feed almost entirely on water fleas (Bosmina), copepods and a few ostracods. Fully developed gizzard shad feed primarily on phytoplankton. This species forms a significant link in the food web of game and predaceous fishes before its rapid growth limits its usefulness.

The carp (Cyprinus carpio) spawns in late spring and early summer in vegetated bottoms. Eggs are randomly deposited and many may stick to plants. Goldfish (Carassius auratus) spawning is similar to that of the carp but is not accompanied by the splashing activities that characterize the carp. Spawning does not begin until temperatures reach a level of at least 17°C (62.6°F), may continue for several weeks, and ceases at 28.0°C (82.4°F). Hatching takes place within three to six days depending upon water temperature. Carp and goldfish are omnivorous and consume a variety of plant and animal tissue. Many kinds of aquatic insects, crustaceans, annelids and molluscs are among the animals eaten; plant tissues include many kinds of weed and tree seeds and algae. Young are fed upon by a variety of predaceous fishes and birds.

The yellow perch (Perca flavescens) spawns in the spring at 6.7 to 12.2°C (44 to 54°F) dropping eggs in long ribbons over submerged brush, vegetation or fallen trees and, at times, over sand or gravel. These ribbons undulate with water movement and can be easily cast ashore by wind, waves or current, and lost. There is no parental care for eggs or young, and eggs usually hatch within eight to ten days after fertilization The hatched young are transparent and inactive for about five days. Yellow perch are most abundant in clear open water of lakes and least abundant in bodies of water where turbidity increases as vegetation decreases. This species is more tolerant of low oxygen than sunfishes. The young feed on cladocerans, ostracods, and chironomid larvae. By the end of their first year they shift to aquatic insect larvae, molluscs, ostracods, chironomid larvae and small fishes. Perch over 150 mm (6 in) feed on decapods, small fishes and Odonata nymphs. The yellow perch is preyed upon by most predatory fishes such as bass, sunfishes,

crappies, walleye (Stizostedion vitreum), northern pike and other yellow perch.

Rock bass (Ambloplites rupustris) spawning takes place in the late spring and early summer. The male digs a shallow nest in areas as diverse as swamps and gravel shoals. The eggs are adhesive, and one female may spawn in more than one nest. Hatching takes place within three to four days at 20.5 to 21°C (68.9 to 69.8°F). Males usually guard the nests and later brood the young for a short time. Food of this species is largely aquatic insects (immature or adults), crayfish, and small fishes. This species competes with smallmouth bass for food.

The smallmouth bass (Micropterus dolomieui) usually spawns over a period of 6 to 10 days in the late spring and early summer. This species builds a nest in sandy gravel or rock bottom of lakes and rivers. Eggs are guarded by the male and hatching takes place in 4 to 10 days depending on the thermal conditions. Young smallmouth bass feed initially on plankton which is replaced by insects when the young reach 20 mm (3/4 in) length. By 50 mm (2 in), fishes and crayfish are the important foods. The young of this species are probably
12 eaten by many predators, particularly rock bass; this apparently results in a significant loss of eggs and fry.

The white bass (Morone chrysops) spawns in spring. Sexually mature fish form unisexual schools and move upstream to shallows for spawning when water temperature rises to 12.8 - 15.8°C (55 to 60°F). The eggs and sperm are released simultaneously near the surface or in midwater; the eggs becoming fertilized as they sink. No parental care is given to eggs or young. Eggs hatch in 46 hours at 15.6°C (60°F). White bass appear to prefer clear water.

This species is carnivorous. The younger, smaller fish feed on microscopic crustaceans, insect larvae and fishes. Yellow perch become increasingly important in the diet with increase in size. Adult white bass feed largely on fish, particularly gizzard shad, yellow perch, bluegills, carp and black crappies and some aquatic insects.

The black crappie (*Pomoxis nigromaculatus*) spawns in late spring and early summer starting when water temperature is 18.9 to 20°C (66 to 68°F). Occupation of spawning territory and nest building by males can begin slightly earlier. Males clear out shallow depressions or just clear a section of the bottom of sand, gravel or mud where there is some vegetation. Males guard the nests, guard and fan the eggs until they hatch, and guard the young for a short time. Eggs hatch in three to five days. The black crappie is usually found in the clear warm water of large ponds and areas of slow current in larger rivers. Young crappie feed on planktonic crustaceans and dipterous larvae into the third year of life. Beyond the 160 mm (6 in) length, the crappie begins to feed on small fish. The young of the black crappie are probably the prey of a variety of warmwater predaceous fishes such as northern pike, smallmouth bass and larger sunfishes.

Northern pike (*Esox lucius*) is a spring spawner when water temperatures are 4.4 to 11.1°C (40 to 52°F) during daylight hours on the heavily vegetated floodplains of rivers, marshes and bays of larger lakes. Eggs hatch in 12 to 14 days. Young pike feed heavily on large zooplankton and immature aquatic insects. Small fish assume predominance in the diet when the young reach 50 mm (2 in). Adult pike can be classed as omnivorous carnivores in that they
12 eat virtually any living vertebrate that they can swallow.

Channel catfish (Ictaluras punctatus) spawn in spring or summer when water
12 temperature is around 27°C (80°F). Males build nests in secluded areas. Also, males protect the eggs, aerate and clean the eggs by fanning with the paired fins, and pack the eggs with body and fins. Eggs hatch in 5 to 10 days at temperatures from 15.6 to 27.8°C (60 to 82°F). Newly hatched larvae remain on the bottom for two to five days and then swim to the surface and begin to feed. The young feed primarily on aquatic insects. Older fish feed on mayflies, caddisflies, chironomids, molluscs, crayfish, crabs, green algae, larger water plants, tree seeds, and fishes. The young may be eaten by a variety of predators, but large adults, due to their size, are probably free from predators.

Salmonids are planted in the area as part of a statewide fishery program. The life cycles of coho and chinook salmon (Oncorhynchus kisutch and O. tshawytscha) are three or four and four or five years, respectively. Food of the salmon varies from one place to another and with time. In the Great Lakes, rainbow smelt (Osmerus mordax) and alewife (Alosa pseudoharengus) make up the bulk of the food taken. Gizzard shad and smelt have been identified as important food for different landlocked salmon populations.

Temperature Tolerances

Studies during the early 1970s indicated the water quality in the Tittabawassee River was improving, since game fish appeared in the segment of
12 the river downstream from the City of Midland[6] in 1973 where none were collected in 1971[7]. Therefore, it appears that a balanced local fish population can be established in the vicinity of the Midland Plant.

12 Temperature tolerance values are the indices of thermal ranges that fishes can withstand without mortality. Temperature tolerance is dependent on the acclimation temperature and season[11]. The maximum and minimum water temperatures tolerated by the fish that are presumed to exist in the Tittabawassee River are given in Table 2.2-2. Temperatures that would be lethal are avoided by fish under conditions that might occur in a mixing zone at the point of a thermal discharge[12]. This information has bearing on the area of the river receiving the heated blowdown water from the Midland Plant cooling pond. Upper lethal limits for most of these species are generally around 30°C (85°F) but may range from 21 to 41°C (69-105°F). These lethal limits are higher in the summer than in the winter, as is shown for some species in Table 2.2-2.

Temperatures needed to maintain a healthy and balanced fish population must also encourage reproduction except for species such as salmonids, that are maintained by stocking. Recognizing this fact, the upper lethal temperatures for the development of embryos of the Tittabawassee River fish species are listed in Table 2.2-3.

Certain species are able to grow at higher temperatures than those required for their spawning and egg development. Spawning is restricted to a narrower temperature range than growth. Thus, eggs and larvae are more susceptible to thermal stress than are adults.

12 2.2.2.1.2 Primary Producers

Plants in the aquatic ecosystem use the energy in sunlight to manufacture complex organic matter from simple inorganic substances through

photosynthesis. These primary producers provide the base of the food chain in the aquatic community. The primary producers are phytoplankton (microscopic algae and some photosynthetic bacteria), periphyton (attached algae), and macrophytes (large rooted aquatic plants). In rivers and streams a floating community may or may not occur, depending on the size of the river and the rate of flow[13]. In general, periphyton and macrophytes are the most important primary producers in a river with phytoplankton playing a minor role.

Phytoplankton in the Tittabawassee River near the Midland Nuclear Plant
12 essentially consist of a composite population of plankton moving downstream from areas such as reservoirs and small impoundments which permit and stimulate production. In the Tittabawassee River below Sanford Lake, pulses of water, originating from hydroelectric power generation, carry algae from quiet backwaters and shoreline areas. These pulsations can cause daily fluctuations in the downstream plankton densities.

The MWRC[7] found that the planktonic algae populations increased in the Tittabawassee River segment downstream from the Midland Plant location (see Figure 2.2-1) with greater numbers of less desirable green and blue-green algae forms ([illegible] to Table 2.2-4 and see Figure 2.2-2). However, this increase apparently did not cause any serious nuisance. The summer 1974 survey[14] indicated increased phytoplankton populations, although lesser representation by blue-greens, as compared with the earlier study (refer to Table 2.2-5).

According to Zillich[5], blue-green algae comprise 61.7% of the periphyton population at the Smith's Crossing Station (refer to Table 2.2-6). The other sample stations located above and below the Dow Dam averaged 5% to 10%

blue-green algae. These values probably represent the maximum population for the blue-greens, because this survey was conducted during the summer season
12 when the blue-green algae usually achieve optimum growth. The increase of periphyton population growth below the Dow Dam is probably the result of a discharge of nutrients essential to the growth of these algae. The phosphate level, which often limits growth of the blue-greens, was considerably higher at Smith's Crossing than at other sampling stations. Downstream from the Dow Dam the standing crop of periphyton exhibited an approximately bell-shaped curve when plotted against the distance (see Figure 2.2-3).

12 Rooted aquatic plants were sparse in the Tittabawassee River[7]. The scarcity of the macrophytes was attributed to the continuous fluctuation of water levels, primarily due to the Sanford or Edenville hydroelectric dam operations upstream from the Midland Nuclear Plant.

12 2.2.2.1.3 <u>Macroinvertebrates</u>

Macroinvertebrates are the primary consumers and rely heavily on the complex organic molecules synthesized by the primary producers. Aquatic macroinvertebrates are often used to evaluate water quality since some species spend their entire life cycle in one localized area. They are used, particularly those with sufficiently long life cycles, to monitor long-term water quality conditions. The continuous monitoring of any environmental variable is superior to periodic sampling because the concentration of contaminants varies with time. Therefore, the ability of macroinvertebrates to integrate their response through time makes them reliable full-time monitors.

Generally, polluted water will support a few kinds of invertebrates that are adapted to feed on organic substrates. This would give a population characterized by very low species diversity; macroinvertebrate communities can thus be classified according to their tolerance status to pollution.

Tolerance status of particular species is generally defined as[7]:

> Tolerant - organisms that can grow and develop within the full range of environmental conditions. They often predominate in water of poor quality where less tolerant types have been eliminated.
>
> Intolerant - organisms whose growth and development are dependent upon a narrow range of environmental conditions. They are rarely found in areas of organic enrichment, cannot adapt to adverse situations, and are replaced by more tolerant organisms if the quality of their environment is degraded.
>
> Facultative - organisms with the ability to survive over a wide range of environmental conditions. They possess "medium" tolerance and often respond positively to moderate organic enrichment but cannot endure severe environmental stresses.

Based upon the MWRC[7] and Zillich[5] investigations, it is possible to identify the community structure of the macroinvertebrates in the Tittabawassee River. The species composition of this group of animals from MWRC is listed in Table 2.2-7.

Table 2.2-8 summarizes the MWRC biological data obtained in 1971[7] from artificial substrates at various locations in the river, as designated in Figure 2.2-1.

Above the Dow Dam, the presence of a diverse and well-balanced macroinvertebrate community indicated clean water conditions. Below the dam, the areas that received The Dow Chemical Company and general wastewater treatment plant discharges had severely degraded water quality conditions.

Macroinvertebrates were limited to midges and sludgeworms. Some recovery was observed from the Freeland Station downstream.

The MWRC[14] 1974 survey yielded data indicating a substantial recovery and biological recuperation at the Smith's Crossing and Freeland Stations and a pronounced improvement below the Midland wastewater treatment plant since 1971. Figure 2.2-4 shows these differences as reflected by biotic index values[14].

12 2.2.2.2 <u>Consumers Power Company's Pilot Investigations</u>

Consumers Power Company, Department of Environmental Services, contracted the
12 Department of Biology of Central Michigan University (CMU) during 1977 and 1978 to survey the biological communities of the Tittabawassee River near Midland and examine various methodologies for future monitoring of these communities. The biological communities investigated were: primary producers (phytoplankton, periphyton, chlorophyll, autotrophic index), macroinvertebrates (including zooplankton), and fish (fish-larvae, juvenile and adult).
12 The 1977 effort is described in a 1978 report[16], while the 1978 data is available in a 1979 report[14a], prepared by Central Michigan University.

12 2.2.2.3 Summary of Consumers Power Company's Preoperational Monitoring During 1979

During 1979, Lawler, Matusky and Skelly Engineers were contracted by Consumers Power Company, Department of Environmental Services, to assess the 1977-1978 pilot investigation data and develop an experimental design for long-term ecological monitoring in the Tittabawassee River. Lawler, Matusky and Skelly Engineers accomplished these tasks through preparation of the reports: Assessment of 1977-78 Data[14b] and Experimental Design of the Long-Term Ecological Monitoring Program of the Tittabawassee River Near the Midland
11 Nuclear Plant[14c]. The State of Michigan Water Resources Commission approved the experimental design for long-term monitoring in October 1979. The initial preoperational year of ecological monitoring using the approved experimental design, as described in Section 6.1.1, was conducted by Lawler, Matusky and Skelly during 1979 and is available in the report, Aquatic Assessment of the Tittabawassee River in the Vicinity of Midland, Michigan[14d]. A summary of this preoperational data is presented below. Refer to Figure 6.1.1a to identify transect and sampling station locations.

12 2.2.2.3.1 Phytoplankton

Whole water phytoplankton samples were collected four times during 1979 on 8 May, 19 June, 10 August, and 12 October at two river stations. The community was composed mainly of three groups: diatoms, green algae, and
11 blue-green algae.

Total phytoplankton abundance fluctuated over time and generally followed a classical pattern of abundance for the latitude of the area sampled. No

consistent differences in abundance between stations were detected. Biovolume
11 information was included in the report as an aid in determining the relative
photosynthetic potential of each dominant taxon.

12 2.2.2.3.2 Periphyton

The periphyton community in the Midland vicinity of the Tittabawassee River is composed primarily of diatoms (Chrysophyta), green algae (Chlorophyta), blue-green algae (Cyanophyta), and Euglenophyta. Statistical analyses were conducted using the abundance data to detect possible differences between sampling dates, transects, and stations.

A statistical rationale for reducing the number of transects to be sampled in
future studies at the Midland Plant site was developed. The technique
11 involved a comparison of the complete data set using the 15-station design vs
the minimal two-station design to determine how reduction of the sampling
strategy would affect the conclusions. The results showed that the only
conclusions lost by the 87% reduction of the data are the significant
seasonality of Chlorophyta and Euglenophyta and the station differences of the
latter. The seasonality is expected and therefore the reduction is not a
major loss to the analysis. In addition, Euglenophyta never account for more
than 10% of the organisms at any station on any date so detectability of such
station differences does not justify the 13 additional stations.

12 2.2.2.3.3 Zooplankton

Three taxonomic groups dominated the Tittabawassee River microzooplankton:
11 rotifers, cladocerans, and copepods. The community structure of river
microzooplankton depends on the following factors: the reproductive strategy

of the various taxa, feeding behavior, competition, predation, and the capacity of populations to increase. The observations serve as a valuable data base for future comparisons. Bosmina coregoni was the most abundant cladoceran species identified in the Tittabawassee River.

Temporal and spatial trends in distribution and abundance were examined visually and statistically through the use of analysis of variance (ANOVA).
11 Seasonality was confirmed in every analysis with a Bonferroni comparison, but spatial heterogeneity was not readily apparent, although Station A_2, in midstream above the Midland Plant intake, tended to have higher densities of microzooplankton. Community analysis revealed that Station D_2, below the Midland Plant intake, had consistently higher diversity (Shannon-Weaver) than A_2, but the small sample size involved may be an incomplete representation of the community structure.

12 2.2.2.3.4 Macroinvertebrates

Macroinvertebrates were collected by Ponar grab samples and artificial substrates in the Midland vicinity of the Tittabawassee River. The results of the Ponar grab samples show that the benthic community is not well established and is most likely sustained by continued colonization from upstream
11 population epicenters. The June 1979 benthic invertebrate data covered five transects of three stations each for a total of 15 collection sites. To determine significant differences among replicates, transects, or stations, the data were analyzed statistically using split plot and whole plot analysis of variance following log transformation of the data.

Significant differences were found only for ephemeropterans, and were among transects. Examination of the June data for each station reveals that a major influence of this transect heterogeneity was the absence of ephemeropterans at one transect. For the total benthos and individual groups, mean abundances were available. Considering that reported abundance values included all
11 macroinvertebrates retained in the Ponar grab, it would seem that, as suggested by the sediment analysis, the benthos community in the river is depauperate.

The number of taxa identified in artificial substrate collections was not much
12 higher than that of the Ponar grab sampler, although the taxa occurred in greater densities. Thus, a more diverse and abundant community of macroinvertebrates was able to develop on the samplers during the approximate six-week immersion periods.

Macroinvertebrates collected on artificial substrates were evaluated for seasonal differences in abundance. The tests revealed that there were significant date differences for all groups tested; one of the major changes
11 in abundance over time involved low densities in October, primarily at Station D_2 downstream of the plant intake. It would appear that, given identical substrates, the two areas (A_2 upstream and D_2 downstream) were able to support similar densities of the dominant macroinvertebrate groups. This is probably related, in part, to colonization from upstream populations so that the two sets of artificial substrate samplers were exposed to the same stock of drifting organisms.

Shannon diversity indices were computed at the taxonomic level of genus. In May and June, the diversity at A_2 was somewhat higher than at D_2. Although

this cannot be accounted for in terms of number of genera, the evenness index and abundances show that there was a more even distribution of organisms among the genera. In August and October, diversity was higher at D_2 than at A_2, partly as a result of the increased evenness index at Station D_2.

The groups of macroinvertebrates (total benthos, Chironomidae, Oligochaeta) examined were consistently more abundant in artificial substrate samples than
11 in Ponar grab samples. This difference was most pronounced for oligochaetes, which suggests that the unstable sandy river bottom was unfavorable for these infaunal taxa. This was tentatively attributed to bottom sediment particle size distribution and low organic content, but the possibility of toxic substances is not ruled out.

12 2.2.2.3.5 <u>Ichthyoplankton</u>

The families Cyprinidae, Centrarchidae, and Percidae were represented by the largest number of species captured in the Tittabawassee River with five, four, and three species collected, respectively. The larval data for cyprinids, centrarchids, emerald shiner, yellow perch, black crappie and white sucker were statistically analyzed by an analysis of variance. Factors which were tested included date sampled, time period of sampling, collection gear, and
11 station location.

The ults of the analysis of variance performed on Cyprinidae showed significant differences in abundance due to date sampled, gear, and station. Centrarchid abundance was significantly different by date, period sampled (day or night), gear used, and a gear x period interaction. Analysis of black crappie data revealed a significant effect on catch due to date and period

sampled. Emerald shiner and white sucker abundances showed no significant effect due to main factors or interactions. Yellow perch data analysis showed significant effects on catch due to gear, station, and a period by station
11 interaction. The nonsignificance of the period and date of the above species may be a result of the low statistical power of the test because capture occurred on only a few dates.

12 2.2.2.3.6 <u>Fisheries</u>

A total of 11,704 fishes representing 11 families and 41 species were collected by electrofishing, seining, and trap netting from the Tittabawassee River in the vicinity of the Consumers Power Midland Plant in 1979.

The fish community is dominated by warmwater species, primarily of the families Cyprinidae and Centrarchidae. Electrofishing was the most successful collection technique, followed by seining and trap netting. Eight selected
11 species of interest were analyzed by a log transformed split plot analysis of variance for each collection gear to define changes at the species level over space and time.

An analysis of community structure was performed using four measures of diversity: the number of taxa, the number of individuals, the evenness of distribution of individuals among the taxa, and a Shannon-Weaver diversity statistic (H'). Species diversity between transects, sampling dates, and gear types showed no consistent trends. However, electrofishing samples had generally higher diversity values than other gear types and September and October collections tended to have higher diversity values. It would appear that electroshocking is the most overall effective collection device, but trap

netting and seining captured species not collected by electroshocking. The
11 use of the Shannon-Weaver information statistic in defining aquatic community structure was discussed.

2.2.2.3.7 Water Quality

12

Two trends are evident in the water quality data. The first is the influence that Lingle Drain exerts on Station D_3 (immediately downstream of Lingle Drain), especially during low flow periods when Station D_3 is isolated from the rest of the river by a large sandbar. There is no indication that this sandbar will disappear in the future; therefore, the influence of Lingle Drain on Station D_3 can be expected to recur as long as the sandbar is present. The second trend is the influence or Dow discharge (downstream of the plant
11 intake) on sampling stations (Transects B, C, and D). Flow characteristics of the river seem to determine which stations are affected. During periods of low flow, shoreline and midstream sampling stations are influenced by Dow's discharge. However, as flow increases, the "plume" appears to hug the shoreline and does not influence midstream areas.

12 2.2.2.3.8 Bottom Sediments

Comparison of the data indicates that silver, arsenic, beryllium, cadmium, and nickel were found in low concentrations at all stations except A_1 upstream of the plant and generally decreased in value between June and October. Copper,
11 zinc, and total organic carbon (TOC) concentrations increased between sampling dates while lead values remained fairly constant between June and October. One parameter, manganese, exhibited wide variations between sampling dates.

The October manganese concentrations are abnormally high and should be interpreted cautiously, although no procedural or computational errors were detected during the investigation.

The particle size distribution data indicate that the bottom sediments were composed mainly of larger fractions, medium sand to gravel, with medium sand dominating 73% of all samples and silt and clay comprising less than 10%, by weight, of most samples. These larger grain sizes necessarily reduce the
11 available area for absorption by the various ions. This helps explain the low values of certain parameters and reinforces the caution with which the manganese levels should be viewed. Seasonal redistribution of sediment composition was noted, but deeper water stations exhibited fewer seasonal changes than the shallower stations. Organic content has been shown to be inversely related to grain size, thus the observed low TOC recorded in the river sediments is consistent with the coarse grained substrate found there.

12 2.2.2.3.9 Impingement

Impingement of fishes occurred during a three-day period in March 1979 when 255×10^6 gal of water was pumped from the Tittabawassee River into the Midland Plant cooling pond. The flow in the river at this time was moderately high.

11

A three-day compilation of data cannot be extrapolated to make any prediction concerning the annual impingement rate. However, it can be postulated from these data that yearling yellow perch will probably dominate future impingement collections taken during similar time periods and that the total

11 number of fish impinged will likely be low in a two-pump mode of operation when river flows are moderately high.

2.2.2.3.10 Fish Migration

12 The impingement of young-of-the-year yellow perch during the fall 1978 portion of the filling of the Midland Plant cooling pond raised questions regarding the origin of the yellow perch involved. More precisely, information was required to determine whether this was a one-year phenomenon resulting from
11 the 1978 Sanford Lake drawdown or an expected annual occurrence. In addition, the study attempted to determine if the yellow perch were the progeny of a residential population or the result of the influx of young-of-the-year individuals from other spawning areas such as Sanford Lake or Saginaw Bay.
12 The conclusions of the study suggest that impingement of yellow perch can be
11 expected during the fall season.

TABLE 2.2-1a

IMPORTANT SPECIES WHICH MAY BE FOUND ON OR NEAR THE MIDLAND PLANT 345 kV RIGHT-OF-WAY[a]

BIRDS

UPLAND GAME

- Ruffed grouse Bonasa umbellus[a]
- Woodcock Philohela minor[a]
- Mourning dove Zenaidura macroura[a]
- Ring-necked pheasant Phasianus colchicus[a]
- Bobwhite quail Colinus virginianus

BIRDS ASSOCIATED WITH THE MIDLAND PLANT COOLING POND[a,b]

- Common loon Gavia immer
- Horned grebe Podiceps a...us
- Pied-billed grebe Podilymbus podiceps
- Red-necked grebe Podiceps grisegena
- Western grebe Aechmophorous occidentalis
- Eared grebe Colymbus californicus
- White pelican Pelecanus erythrorhynchos
- 12 Double-crested cormorant Phalacrocorax auritus[c]
- Whistling swan Cygnus columbianus
- Canada goose Branta canadensis
- Blue goose Anser caerulescens
- Mallard Anas platyrhynchos
- Black duck Anas rubripes
- Pintail Anas acuta
- Gadwall Anas strepera
- American widgeon Anas americana
- Shoveler Anas clypeata
- Blue-winged teal Anas discors
- Green-winged teal Anas crecca
- Wood duck Aix sponsa
- Redhead Aythya americana
- Canvasback Aythya valisneria
- Ring-necked duck Aythya collaris
- 12 Lesser scaup Aythya affinis
- Greater scaup Aythya marila
- Common goldeneye Bucephala clangula
- Bufflehead Bucephala albeola
- Oldsquaw Clangula hyemalis
- White-winged scoter Melanitta fusca
- Ruddy duck Oxyura jamaicensis
- Common merganser Mergus merganser
- Red-breasted merganser Mergus serrator
- Hooded merganser Mergus cucullatus
- Osprey Pand..on haliaetus[c]
- Great blue heron Ardea herodias
- Little blue heron Florida caerulea
- Green heron Butorides virescens
- Common egret Casmerodius albus
- Black-crowned night heron Nycticorax nycticorax
- American coot Fulica americana
- Killdeer Charadrius vociferus
- Spotted sandpiper Actitis macularia
- Greater yellowlegs Totanus melanoleucus
- Lesser yellowlegs Tringa flavipes
- Sande...g Calidris alba
- Dunlin ... alpina
- Ruddy turnstone Arenaria interpres
- Herring gull Larus argentatus
- Ring-billed gull Larus delawarensis
- Bonaparte's gull Larus philadelphia
- Common tern Sterna hirundo (addition to proposed 1979 State list)
- Caspian tern Hydroprogne caspia (addition to proposed 1979 State list)
- Black tern Chlidonias niger

HAWKS AND OWLS

- Red-tailed hawk Buteo jamaicensis[a]
- Broad-winged hawk Buteo platypterus
- Rough-legged hawk Buteo lagopus[a]
- American kestrel Falco sparverius[a]
- Pigeon hawk Falco columbarius
- Goshawk Accipiter gentilis
- Screech owl Otus asio
- Great horned owl Bubo virginianus
- Long-eared owl Asio otus
- Short-eared owl Asio flammeus
- Saw-whet owl Aegolius acadicus

ENDANGERED[c,d]

- Peregrine falcon .alco peregrinus (as migrant only)
- 4 Kirtland's warbler Dendroica kirtlandii (as migrant only)

THREATENED[c,d]

- Cooper's hawk Accipiter cooperi[a]
- Red-shouldered hawk Buteo lineatus
- Bald eagle Haliaetus leucocephalus
- 12 Marsh hawk Circus cyaneus[a]

Barn owl *Tyto alba*

4 Loggerhead shrike *Lanius ludovicianus*

MAMMALS

GAME ANIMALS

Woodchuck *Marmota monax*[a]

Eastern fox squirrel *Sciurus niger*[a]

4 Gray squirrel *Sciurus carolinensis*

Eastern cottontail *Sylvilagus floridanus*[a]

12 Whitetail deer *Odocoileus virginianus*[a]

Black bear *Ursus americanus* (peripheral)

FURBEARERS

Badger *Taxidea taxus*[a]

Opossum *Didelphis virginiana*[a]

Striped skunk *Mephitis mephitis*[a]

Raccoon *Procyon lotor*[a]

Beaver *Castor canadensis* (peripheral)

Long-tailed weasel *Mustela frenata*

Mink *Mustela vison*[a]

Gray fox *Urocyon cinereoargenteus* (peripheral)

Red fox *Vulpes fulva*[a]

4 Muskrat *Ondatra zibethicus*[a]

ENDANGERED[c]

None

THREATENED[c]

Southern bog lemming *Synaptomys cooperi*

REPTILES AND AMPHIBIANS

IMPORTANT

Bullfrog *Rana catesbiana*

Snapping turtle *Chelydra serpentina*

ENDANGERED[c]

None

THREATENED[c]

Elaphe obsoleta (Say)

Threatened - Michigan

Black rat snake

Habitat: Habitat varies from rocky, timbered hillsides to flat farmlands and coastal plains. Woodlots and agricultural lands in the study area could provide habitat for this species.

PLANTS

IMPORTANT[a]

Swamp white oak *Quercus bicolor*

Red oak *Q. borealis*

Pin oak *Q. palustris*

Red maple *Acer rubrum*

Large-toothed aspen *Populus grandidentata*

Quaking aspen *P. tremuloides*

Speckled alder *Alnus incana*

Red pine *Pinus resinosa*

Narrowleaf meadowsweet *Spirea alba*

Witch hazel *Hamamelis virginiana*

12 Lowbush blueberry *Vaccinium vacillans*

Green ash *Fraxinus pennsylvanica*

Hawthorne *Crataegus* sp.

Bitternut hickory *Carya cordiformis*

Sassafras *Sassafras albidum*

Large cranberry *Vaccinium macrocarpon*

Highbush cranberry *Vaccinium corymbosum*

Buttonbush *Cephalanthus occidentalis*

Poison ivy *Rhus radicans*

Wintergreen *Gaultheria procumbens*

Aster *Aster* sp.

False Solomon's seal *Smilacina* sp.

Nettles *Urtica* sp.

Sphagnum moss *Sphagnum* sp.

Queen Anne's lace *Daucus carota*

Mullein *Verbascum thapsus*

Yarrow *Achillea millefolium*

Pearly everlasting *Anaphalis margaritacea*

Bracken fern *Osmunda claytoniana*

Blackberry *Rubus allegheniensis*

Goldenrod *Solidago* sp.

Summer grape *Vitis aestivalis*

Moneywort *Lysimachia nummularia*

Dodder *Cuscuta gronovii*

Smartweed *Polygonum* sp.

Cutgrass *Leersia* sp.

ENDANGERED[c]

None

THREATENED[c]

Orange fringed orchid *Habenaria ciliaris*

Prairie fringed orchid *Habenaria leucophaea*

Slough grass *Beckmannia syzigachne*

Feathergrass *Stipa comata*

Milkweed *Asclepias hirtella*

Ram's-head lady's slipper *Cypripedium arietinum*

Sedge *Carex aerosa*

Blue-eyed grass *Sisyrinchium atlanticum*

Diarrhena americana

False pimpernel *Lindernia anagallides*

Sedge *Carex platyphylla*

Tubercled orchid *Habenaria flava*

Trillium *Trillium viride*

(a) Species or their definitive sign observed by Consumers Power Company staff or consultants.

(b) These birds are primarily associated with the cooling pond, but may occasionally be impacted by the transmission facilities.

(c) State or Federal threatened or endangered species.

4 (d) Endangered and threatened species primarily associated with the Midland Plant cooling pond are noted in that section above.

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2.4 HYDROLOGY

Throughout this section (text and tables) metric and English units are used where applicable for various measurements. The appropriate conversion factors are:

1 meter	=	3 .281 feet
1 mile	=	1.609 kilometers
1 square mile	=	2.59 square kilometers
1 acre	=	0.4038 hectares
1 inch	=	2.54 centimeters

2.4.1 Hydrologic Description

The Plant is located on the south bank of the Tittabawassee River partially
12 within the southern extremes of the city limits of Midland, Michigan. The Dow Chemical Company's main industrial complex lies directly north of the Plant and provides an area of controlled access of about 2 miles between the reactor site and the Midland business and residential district. Figure 2.4-1 characterizes the Plant environs and shows the approximate site boundaries. Figure 2.4-2 is a plan of the Plant area which shows the finished grade at elevation 634 feet mean sea level (msl). As shown in Figure 2.4-2, a large pond (herein referred to as the cooling pond) is constructed with earth dikes to serve as a storage reservoir and cooling pond. A detailed discussion of the cooling pond is provided in Sections 3.4.3 and 3.4.4.

The dominant surface hydrological feature of the site region is the Tittabawassee River. The river flows generally southward to a point about 10 miles upstream from Midland. At this point it meanders to the southeast and

empties into the Saginaw River at the City of Saginaw, about 20 miles downstream from Midland. The Saginaw River is formed by the confluence of four main tributaries: the Tittabawassee, Shiawassee, Flint, and Cass Rivers. About 22 miles downstream from its confluence with the Tittabawassee, the Saginaw River flows into Saginaw Bay, an arm of Lake Huron. A regional map showing the location of the major hydrologic features with respect to the Plant is shown in Figure 2.4-3.

The length of the Tittabawassee River from headwaters to mouth is about 85 miles. Principal tributaries upstream from Midland are the Molasses River from the east and the Tobacco, Salt, Chippewa, and Pine Rivers from the west. The fan-shaped drainage area above Midland encompasses 2,400 square miles. The drainage basin is shown in Figure 2.4-4. The topography does not have pronounced relief and is characterized by many lakes and swampy areas. Less than half of the drainage area is forested. Many of the lowlands have been drained by the construction of canals and ditches. There are no known municipalities or industries which withdraw water from the Tittabawassee River downstream of the Plant.

Bullock Creek with diverted Branch No 1 and Waite and Debolt Drains has a drainage area of 40 square miles and flows into the Tittabawassee River just upstream from the Plant, as shown in Figure 2.4-2. Prior to Plant construction, Bullock Creek flowed adjacent to the Plant fill area. Branch No 1 Drain joined Waite and Debolt Drains in the middle of the cooling pond area and discharged into the Tittabawassee River on the eastern side of the Plant. To accommodate the construction laydown area and cooling pond, Bullock Creek was rerouted to its present location, as shown in Figure 2.4-2. Branch No 1

and Waite and Debolt Drains were diverted into Bullock Creek approximately 3,000 feet from its mouth. Overflow from extreme floods in the Creek will spread over the low-lying adjacent area and will not present a threat to the Plant. The Bullock Creek channel can accommodate the estimated 100-year flood of 3,700 cfs.

1 Table 2.1-16 lists those bodies of water in the watershed within the 50-mile radius of the Plant having a surface area of 100 acres or more. In addition to the lakes listed, about 440,000 acres of Saginaw Bay, an arm of Lake Huron, are also within the 50-mile radius. Several municipalities and water districts obtain their water supplies from this portion of the Bay. The location of their intakes is listed in Table 2.1-17 and shown in Figure 2.1-17.

There are numerous dams and reservoirs in the Tittabawassee basin upstream of Midland, but most are either of low head or very small storage capacity. Table 2.4-1 provides pertinent information regarding the larger dams upstream from the Plant.

2.4.2 River Flow Data

The US Geological Survey (USGS) has operated a gaging station about a mile upstream from the Plant on the Tittabawassee River since March 1936. The re-
12 corded river flows are unadjusted for diversion made by The Dow Chemical Company a short distance upstream of the gage. The average annual diversion flow from 1937 through 1975 is 80.6 cfs, as published by the USGS. The US Weather Bureau collected records of river levels in the vicinity during the flood seasons of 1910-1926 which were published by the USGS[1] together with peak data of the floods of 1876 and 1907. Table 2.4-2 is a summary of the average

monthly mean and extreme flows at the USGS Midland gage for water years 1937 through 1975.

Upstream of the Midland gaging station, river flow records are available from the USGS for the Tobacco, Chippewa and Pine Rivers which are tributaries of the Tittabawassee River. Downstream from the Plant, no records of daily flow rates have been maintained on the Saginaw River. The USGS has, however, operated gaging stations on the Saginaw River's four main tributaries since the 1930s. These records, plus that for the Bad River, a Shiawassee River tributary downstream from the Fergus Station, are summarized in Table 2.4-3. The location of the gaging stations, with respect to the Plant, is shown in Figure 2.4-3.

2.4.3 Floods

2.4.3.1 Flood History

The maximum historical flood at the Midland gage since at least 1907, as published by the USGS[1], reached a stage of 610.0 feet msl in 1916 with a peak discharge of 34,800 cfs. During the period of operation of the USGS gaging station, the maximum flood recorded was 34,000 cfs in 1948. The peak water level for this flood was 609.8 feet msl.

2.4.3.2 Flood Design Considerations

An investigation was made to determine the maximum water level due to hypothetical floods (refer to Section 2.4.4). The event producing the most critical flood level is the Probable Maximum Flood (PMF). The study included a possible "domino" effect in the failure of the upstream dams. By adding the

routed dam-failure hydrograph to the natural probable maximum discharge, a maximum wave-free level of 631 feet msl at the Plant is predicted. The Plant grade at elevation 634 feet msl provides over 3 feet of freeboard against the wave-free flood level.

Wind generated waves occurring during the maximum flood stage were analyzed. The overwater wind speed was computed to be 51 mph from the northwest. The run-up of the significant and 1% waves on the northwest edge of the Plant could possibly carry water onto the Plant site. An emergency procedure is therefore provided directing that critical openings be sandbagged under such adverse conditions.

2.4.4 Probable Maximum Flood (PMF)

The probable maximum discharge and stage of the Tittabawassee River at the Midland Plant have been determined from a detailed study as discussed in the FSAR[2]. The primary consideration in determining the flood potential is the maximum possible depth of precipitation which can occur over the contributing drainage basin of 2,400 square miles upstream from the Plant. The resulting peak discharge together with the effects of failure of the upstream dams due to overtopping produce the probable maximum stage at the Plant location.

In 1956, E F Brater and C O Wisler[3], professors at the University of Michigan, made a study of the PMF in the Tittabawassee River at Midland for The Dow Chemical Company. In this study, the PMF to be expected from rain 12 alone and that from a combination of rainfall and snowmelt were computed. The basic rainfall-runoff results determined by Brater and Wisler are adopted

herein. Their analysis of the effects of failure of the upstream dams due to overtopping has been revised[2].

2.4.4.1 Probable Maximum Precipitation (PMP)

The procedures outlined in the US Weather Bureau's Hydrometeorological Report No 33[4] are used to develop the Probable Maximum Precipitation (PMP) which would occur over the drainage area. As shown in Table 2.4-4, 24-hour duration storms are calculated for each month of the year. The table also shows the 24-hour maximum potential snowmelt as determined from analysis of runoff and temperature records in the Tittabawassee basin. The runoff from the June PMP is greater than that from any storm accompanied by snowmelt. The PMP is determined to be 13.0 inches in 24 hours over 2,400 square miles preceded by 1.0 inch in the previous 24 hours occurring in June with no snowmelt.

2.4.4.2 Precipitation Losses

Infiltration rates are determined for each month based upon 25 storm runoff hydrographs[3]. To incorporate the effects of antecedent moisture, intensity of precipitation, and the possible effects of ice on the ground, a lower envelope of observed infiltration rates is used rather than the average observed values. The infiltration rates thus derived vary monthly from near zero for March to about 0.8 inch per day from August to January. For June, the lower bound infiltration rate is 0.4 inch per day. The initial abstraction is taken as 0.1 inch. The average depth of rainfall excess over the drainage basin resulting from the 24-hour PMP plus the previous 24-hour antecedent storm amounts to 13.1 inches.

2.4.4.3 Runoff and Stream Course Models

The hydrologic response characteristics of the watershed to precipitation have been analyzed[2]. The 2,400 square mile drainage basin is shown in Figure 2.4.4.

Unit hydrographs from the runoff and precipitation records of a number of large storms have been developed[3]. These were done for 24-hour rainfalls and are very consistent between storms. The most typical unit hydrograph for the basin, which is approximately the average of those computed, is presented in Figure 2.4-5.

The US Corps of Engineers has also made flood studies in the Tittabawassee drainage basin[5]. As shown in Figure 2.4-5, their unit hydrograph is in good agreement with the one developed by Brater and Wisler[3] used in this analysis.

Probable maximum rainfalls from the US Weather Bureau's Hydrometeorological Report No 33[4] after modification for the precipitation losses were applied to the unit hydrograph. The prediction of peak flows by this procedure is verified by application to three major floods at Midland. The results are as follows:

Peak Discharge

(cfs)

Flood Date	Actual	Computed
March 1942	26,100	26,000
March 1948	34,000	31,400
May 1912	48,000	52,000

The 48,000 cfs peak discharge that occurred in May 1912 is not a recorded value but it was estimated from US Weather Bureau rain gage recordings(3).

2.4.4.4 Probable Maximum Flood Flow

The hydrograph of the Tittabawassee River's natural PMF near the Plant was developed using the unit hydrograph developed by Brater and Wisler(3) shown in Figure 2.4-5, and the probable maximum precipitation and the infiltration losses shown in Figure 2.4-6. Rainfall excess was obtained by subtracting the losses from the rainfall and was applied to the unit hydrograph to obtain the natural PMF hydrograph in Figure 2.4-6. As indicated by the hydrograph, the maximum flow excluding the effect of any dam failure is 248,000 cfs.

There are six existing hydroelectric power plant reservoirs in the Tittabawassee basin. All are located upstream of Midland, Michigan and have dams of earth construction with concrete spillways. Table 2.4-1 gives some of their characteristics. To evaluate the effect of dam failure upon the maximum discharge and maximum water level at the Plant, a reasonable mode and time of failure is required. The worst condition would be if Secord, Smallwood, Edenville, and Sanford Dams were to fail successively downstream. To allow

for a possible "domino" effect in the failure of the upstream dams, the total storage behind all four dams could be treated as concentrated at the dam farthest downstream, Sanford Dam.

A failure hydrograph at Sanford Dam was developed(2) and routed by the storage coefficient method(2) through the Tittabawassee River to the Midland Plant, using an average velocity of 3.5 ft/s, time increments of 6 hours, and channel storage coefficient of 0.10. The assumed velocity and coefficient are considered appropriate for the PMF condition.

Figure 2.4-6 shows the channel routed hydrograph. As presented in FSAR Section 2.4.3, dam failure occurs early on the rising limb of the flood hydrograph and reduces the significance of the routing coefficients. The dam breach is actually a relatively minor contribution to the total peak flow past the Plant. By adding the routed dam failure hydrograph to the natural PMF at the Plant, a combined peak flow of approximately 262,000 cfs results.

The possibility of a simultaneous occurrence of two flood peaks resulting from a seismically induced dam break and a runoff flood was investigated. In Figure 2.4-6, the total peak discharge resulting from the addition of the dam failure peak (63,000 cfs) with the estimated standard project flood peak (half of the PMF, ie, 124,000 cfs) yields a total flood discharge of 187,000 cfs at the Plant. The flood level from this combination of events is lower than the PMF level.

2.4.4.5 Maximum Water Level

To determine the water level that would result at the Plant site from the PMF peak discharge of 262,000 cfs (which includes the upstream dam failure),

rating curve calculations were made using conservative channel and flood plain flow resistance and downstream water levels. Calculations were made using a US Corps of Engineers originated computer program(6) which incorporates the standard step backwater method. From the rating curve and the PMF discharge hydrograph, the PMF stage hydrograph at the Plant is developed which shows that the peak water level in the Tittabawassee River under postconstruction conditions would be at about 631 feet msl.

2.4.5 Low Flow Considerations

2.4.5.1 Low Flow in the Tittabawassee River

Although the river flow is not related to the continued safety of the Midland Plant, it is related to the continuous electrical generating capability. Based on a detailed study of river discharges, a 100-day drought was established as the design criteria for sizing the cooling pond(2). The quantity of water which may be withdrawn from the river for use as makeup to
1 the pond is a function of the river flow rate as presented in Table 3.4-6.

It is anticipated that during an average year the withdrawal rate will be about 46 cfs. Twenty-eight cfs will be required to replace pond losses and
9 the remainder (18 cfs) is available for blowdown. The pond losses consist of an average monthly evaporation rate of 27.5 cfs with the remainder allowed for seepage losses. The evaporation losses were determined using empirical methods based on monthly wind speed and air vapor pressure data(7). The meteorological data were obtained from weather stations at Midland and Saginaw, Michigan. Blowdown is returned to the river. During initial filling
1 of the pond, all river water in excess of 350 cfs in accordance with Table 3.4-6, up to a withdrawal rate of 134 cfs, is withdrawn until the pond is

full. Two pumps are used for the initial pond filling with the third pump on standby.

The 90-day low flow frequency curve shown in Figure 2.4-7 was developed using the 90-day flow duration data compiled by the USGS at Midland. The Midland gage record used was not adjusted for any flow diversions upstream from the gage. Based on the curve, it is estimated that there is about an 18% probability that the lowest mean river discharge for 90 consecutive days will drop below 350 cfs and thus limit river withdrawal. Further, it is estimated that there is about a 30% probability that the lowest mean river discharge, for 90 consecutive days, will be below 390 cfs and therefore will not allow continuous withdrawal of a full 40 cfs. The percent probabilities of having 100-day droughts of these magnitudes would be correspondingly less. The 7-day, 10-year low flow at the USGS Midland gage for the period 1936-1975 is computed to equal 170 cfs, unadjusted for diversion.

2.4.5.2 Historical Low Water

The minimum historical instantaneous flow at the USGS Midland gage based on the 39 years of record through 1975 is 39 cfs and occurred October 12, 1942. The minimum daily flow is 111 cfs and occurred August 21, 1949. The most severe 12 consecutive months of drought for the period of record occurred during 1944-1945. Table 2.4-5 lists the monthly flow sequence of this 12-month low flow period.

A daily flow duration curve was developed utilizing river flows unadjusted for diversion and is shown in Figure 2.4-8. As indicated by the curve, the

Tittabawassee River flow can be expected to exceed 200 cfs 96% of the time, and 350 cfs 82% of the time.

Analysis of river discharges for the period of record show that in 5 of the 39 years there were periods of 90 consecutive days in which the mean low flow was less than 350 cfs (1936, 1941, 1944, 1946, and 1948); in 4 of those years (1936, 1944, 1946, and 1948), there were 120 consecutive days. However, during the most severe 120-day period there were 29 days that had average flow in excess of 350 cfs. These data do not consider any adjustments for diversions upstream of the Midland gage. Table 2.4-6 summarizes information on long-term, low-flow conditions.

2.4.6 Physical, Chemical, and Biological Characteristics of Surface Waters

2.4.6.1 Records and Data

The water quality monitoring program conducted by The Dow Chemical Company is described in Section 6.3.4. Results of this monitoring are available in
12 Monthly Operating Reports submitted by Dow to the Michigan Water Resources Commission.

The water quality at different locations on the Tittabawassee River, and the interrelation with living organisms, have been investigated in several studies. Zillich[8] and MDNR[9] sampled the river and determined the chemical characteristics of water and bottom sediments in the early 1970s. Generally,
12 these studies were intended to investigate the aquatic community structure on the basis of water quality. Following is a summary of these reports.

In 1973, Zillich[8] reported total dissolved solids concentrations above
Midland to be 200 mg/l. The concentrations of chloride and ammonia were 16
mg/l and 0.5 mg/l, respectively. However, in contrast, between the City of
12 Midland and the Midland/Bay County line, the Tittabawassee River experienced
substandard water quality. The most serious reach of substandard quality was
found below the City of Midland. This reach receives the effluent from the
Midland Wastewater Treatment Plant as well as discharges from The Dow Chemical
Company complex. Dissolved solids concentrations that exceeded applicable
water quality standards were reported by Zillich[8] to be as high as
12 1,100 mg/l. Chloride concentrations were measured at 360 mg/l. However,
chloride concentrations in the Pine River have exceeded 700 mg/l. Groundwater
has been identified as a significant contributor of chloride in the
Tittabawassee Drainage Basin[10].

Ammonia has also reached high concentrations at times as a result of municipal
12 wastewater discharges. In 1973 Zillich[8] reported ammonia levels of 3.6 mg/l
below Midland. Although data reflecting intermittent point source discharges
in Midland are lacking, it is believed that storm activated sewers may
12 contribute a substantial ammonia load during storms. Intermittent point
sources are also responsible for violations of the fecal coliform water
quality standard. Previous water quality studies have shown that very little
nitrification is occurring in the lower reaches of the Tittabawassee River.
This would indicate that most of the oxygen demand exerted by the nitrogenous
12 waste occurs within the Saginaw River[10]. At Smith's Crossing, there are
somewhat elevated levels of phosphorus and organic nitrogen. Dissolved oxygen
12 levels remained above the water quality standards.

12

Metal concentrations in waters, in suspended solids, and in the top one inch
12 of bottom core samples were determined by Zillich[8]. In all cases the
suspended solids and bottom sediments contained much higher concentrations of
the metals than did the waters. Chromium could not be detected in any of the
waters (5 ppb limit of detection), but all of the suspended solid samples were
in the ppm range. Chromium concentrations in the sediments of the
Tittabawassee were 3.9 ppm above Midland, 6.4 ppm in the Pine River at Pine
River Road, and 9 ppm in the Tittabawassee River at Freeland. Chromium
concentrations in the suspended solids were 61 ppm in the Pine River at Pine
River Road, 24 ppm in the Tittabawassee River above Midland, 166 ppm at
Smith's Crossing, 98 ppm at Freeland and 115 ppm at State Street crossing.
Elevated zinc concentrations also occur in the sediments obtained in the Pine
12 River. Concentrations of 16.9 ppm were reported by Zillich[8]. The highest
concentrations of zinc in suspended sediment were recorded below Midland at
2,800 ppm.

The MDNR[9] conducted a survey of the Tittabawassee River in July 1971 to determine levels of hydrocarbon pesticides and polychlorinated biphenyls (PCB's) in water and settleable solids. Dieldrin and DDT levels were well below threshold limits. Concentrations of PCB's in the water samples ranged from 0.010 to 0.029 μg/l. Upstream samples from the Pine and Tittabawassee Rivers were below the level of detectability (0.010 μg/l). This study indicated that the source of PCB contamination was in the Midland area with a reduction downstream due to dilution.

The 1974[11] survey by the MDNR was conducted to analyze the sediments above and below Midland. The sediment analysis did not reveal high concentrations of toxic organics; however, the copper, total chromium, zinc, nickel and lead
12 concentrations were moderate to high. In most cases, the highest concentrations of all metals were detected in those samples taken from a station below the Lingle Drain, an indication of industrial and municipal contribution of contaminants.

Tittabawassee River water quality and bottom sediment data collected during 1977 and 1978 are tabulated in reports prepared by Central Michigan University[11a,11b]. Data collected during 1979 were analyzed by Lawler, Matusky and Skelly Engineers[11c]. These data were collected in the reach of the Tittabawassee River previously reported as substandard relative to water and sediment quality[8,9]. During 1979, upstream total dissolved solid levels averaged 307 mg/l while downstream averaged 396 mg/l. Upstream chloride levels averaged 37.3 mg/l compared to 96.8 mg/l downsteam and ammonia levels averaged 0.02 mg/l upstream compared to 0.28 mg/l downstream. The expected
12 water quality at the Midland Plant river intake structure based on 1979 data is presented in Table 3.6-3. In general, current river water quality data show a noticeable improvement compared to early investigations such as Zillich[8] and Michigan Department of Natural Resources[9].

During 1979, LMS[11c] collected bottom sediment and analyzed for ten metals and total organic carbon. Six samples were collected at a river transient upstream of the Midland Plant intake and six downstream of the Plant near the Freeland Road Bridge. Data were compared to EPA[11d] classification of sediment pollution in Great Lakes Harbor sediments. Based on this comparison,

all downstream sediments were classified as nonpolluted. However, single upstream samples of arsenic (4.3 mg/kg), nickel (29.4 mg/kg) and zinc (121.31 mg/kg) were classified as moderately polluted. Single upstream samples of arsenic (67.64 mg/kg), cadmium (53.61 mg/kg) and copper
12 (464.17 mg/kg) were analyzed at levels indicating heavy pollution. These results compare favorably with the 1974[11] MDNR survey which indicated moderate to high levels of some heavy metals.

2.4.7 Groundwater

2.4.7.1 Description and On-Site Use

The Plant is located in the Lower Peninsula of Michigan near the center of the Michigan Basin, a broad, shallow structural basin of Paleozoic sedimentary rocks up to 14,000 feet thick. These rocks are covered by unconsolidated Pleistocene glacial drift that regionally is about 200 to 300 feet thick. Details of the regional and Plant site geology are discussed in Section 2.5.

2.4.7.1.1 Regional Aquifers

Drift Aquifers

Most of the groundwater development of Michigan's Lower Peninsula is in the sand and gravel zones present in the glacial deposits, with rural areas depending almost entirely on these aquifers for water supply. Several municipalities in the Plant region, such as Ann Arbor, Northville, Alma, St Louis, and Cadillac, get a part of their water supply from these sand and gravel aquifers[14]. Where moraines and till plain features dominate, yields

are generally less than 50 gpm, and where the drift is thin, or has a low permeability, water is obtained from either wells in the bedrock or from surface water sources.

Recharge of aquifers present in the drift occurs either by direct infiltration of precipitation, principally in areas where the aquifer is at or very near the surface, or, for the more deeply buried drift aquifers, recharge is indirectly through more shallow drift aquifers[14].

Bedrock Aquifers

The bedrock units that are extensively tapped as a source of water are the Saginaw formation, Marshall formation, Coldwater shale, Berea sandstone, Traverse group, Detroit River group, and Bass Islands dolomite. Of these, the Saginaw, Marshall, Berea, and the Detroit River group generally yield the greatest quantities of water with some wells producing as much as 300 gpm[15].

Most bedrock aquifers in Michigan's Lower Peninsula are too deeply buried to receive recharge directly from the surface. The dominant sources of replenishment are either indirect infiltration from overlying sand and gravel zones or, where the bedrock occurs sufficiently near the ground surface, from lakes and streams.

Groundwater Quality

Generally, the quality of water in the region varies with well depth and aquifer type. The glacial deposits usually produce higher yields and better quality water than the bedrock aquifers.

In both the bedrock and the glacial deposits, however, the concentration of dissolved solids normally increases as the well depth increases and the quality of ground water deteriorates. Usually the drift aquifers are high in sulfate and iron and very hard while the bedrock aquifers generally are high in sodium and chloride[15].

2.4.7.1.2 <u>Local Aquifers</u>

In the vicinity of the Plant, fresh groundwater supplies are often difficult to obtain because of the scarcity of permeable beds of sand or gravel within the glacial drift and the widespread occurrence of salty or mineralized water in the bedrock formations. A review of the water well records on file at the Michigan Geological Survey revealed that only small amounts of ground water are obtained by wells from the sand and gravel deposits in the drift and, to a lesser extent, from the underlying sandstones of the Saginaw formation.

The unconsolidated deposits beneath the Plant site have been subdivided into lithologic units as shown in Table 2.4-7. The presence of the thick, impermeable clays (Units b and c) separate two groundwater occurrences: an isolated perched water table present in the discontinuous sand (Unit a) above the clays, and a deeper confined aquifer composed of Units d and e (refer to Section 2.5.2).

Within the Plant boundaries, the upper discontinuous sand ranged from 0 to 65 feet thick, with ground water present at or very near the ground surface. The quantity of water in this surface sand is limited and is not a source of domestic or other supply in the area. On the other hand, the confined aquifer
2 is a source of domestic water in the Plant vicinity. Five plant site

investigation borings completely penetrated this aquifer, showing it to be
2 from 0 to 195 feet thick. Water rose to approximately elevation 605 in the
bore holes. Wells in the area (refer to Table 2.4-8) indicate a similar
artesian head is present throughout the area.

In addition to wells in the confined drift aquifer zone, 11 nearby domestic wells extract ground water from the underlying Saginaw formation. Although water in that formation is also confined, the potentiometric surface is lower than that present in the confined drift aquifer. Table 2.4-8 includes both the drift and bedrock water wells on file with the Michigan Geological Survey for the Plant area.

Recharge of the surface sand is mainly by direct infiltration of precipitation
and locally from streams and ponds. In the Plant area, direct recharge of the
2 deeper confined sands and gravels is prevented by the presence of at least 110
feet of impermeable clay (Units b and c) overlying these zones. Most likely
recharge is from distant areas where these sands and gravels either outcrop or
where they are connected with other aquifers.

Recharge of the Saginaw formation aquifers is believed to occur through interconnection with the overlying drift aquifers (Unit a) and through distant outcrop areas. The site investigation indicated that the most shallow bedrock aquifer zone beneath the Plant is confined under about 60 feet of shale; therefore, recharge of this aquifer does not occur at the Plant. Oil and gas well logs for the local area indicate that bedrock sandstone units, just north of the Plant, are in contact with the drift over a relatively large area and local recharge may occur in this area.

2.4.7.1.3 On-Site Use of Ground Water

During operation of the Midland Plant, no groundwater use is planned for the Plant facilities. All makeup and domestic water supplies will be obtained from surface water sources. Two construction water wells have been installed
1 at the Plant. These wells will be sealed prior to the completion of construction.

A water well survey completed during the site investigation located 57 water wells within the Plant site boundaries. Table 2.4-9 lists these wells. All previous existing water wells were sealed during the early phases of construction.

2.4.7.2 Aquifer Utilization and Physical Parameters

2.4.7.2.1 Groundwater Usage

Regional Usage

In the Lower Peninsula of Michigan groundwater development has been from aquifers present in both the glacial drift and the bedrock, as described in Section 2.4.7.1.

In the Tittabawassee River drainage basin, described in Section 2.4.1, 12 municipalities obtain their public water supplies from groundwater sources. Table 2.4-10 lists these cities with their consumption rates and distances from the Midland Plant. The average consumption for these municipal supplies is about 6.2 mgd, with the maximum daily usage at about 8.5 mgd, and the average per capita consumption within these municipal units is approximately 290 gpd. The City of Midland obtains its municipal water from Lake Huron;

therefore, it is not listed. Total industrial groundwater use in the Tittabawassee River basin is about 3 mgd; most of this is obtained from municipal wells[16].

The groundwater usage potential in the Tittabawassee River basin is limited. The heterogeneous nature of the drift aquifers combined with the relatively low yields of both the drift and bedrock aquifers will restrict the development of groundwater usage in the area. Based on available groundwater usage figures (refer to Table 2.4-10) and population projections, in 1980 the average municipal groundwater usage for this basin will be approximately 7.6 mgd.

Local Usage

In the Plant vicinity small amounts of ground water are obtained from the glacial drift and bedrock aquifers. Table 2.4-8 lists all documented wells within 3 miles of the Plant. Based on well yields in this table, the maximum groundwater usage in this 28 square mile area is approximately 2 mgd from the drift and 0.2 mgd from the bedrock. Based on the limited amounts of ground water available in the Plant vicinity, future use of ground water is expected to increase only slightly, with the expectation that the majority of additional water needs will be met by municipal supplies (eg, from Midland) which are obtained from surface sources.

2.4.7.2.2 Groundwater Movement

Three major groundwater systems underlie the Plant:

a. Perched ground water in the surficial sand (Unit a)

b. Confined ground water within the deeper coarse-grained drift materials (Units d and e)

c. Confined ground water in the Saginaw formation.

Descriptions of these materials are presented in Section 2.4.7.1.

Figure 2.4-9 is a contour map of the water table present within the surficial sand. From the figure, the hydraulic gradient across the Plant site varies from approximately 0.0043 to 0.05, with an estimated average of 0.01 toward the Tittabawassee River. A survey of nearby borrow pits and drainage ditches in the Plant area indicated that this general direction of groundwater flow persists for several miles south and west of the Plant, although southward the gradient is somewhat less.

Water level data from local wells are insufficient to determine a direction of local groundwater movement within the confined drift aquifer, or within the Saginaw formation. However, from a regional aspect, they are estimated to have a nearly flat gradient sloping generally northeast.

Laboratory permeability and density tests on nine samples of the surficial sand (Unit a) were conducted. Values ranged from 2.8 to 4,274 feet per year. The average permeability of the nine samples is 1,053 ft/yr and bulk density is 113 lb/ft^3. An effective porosity of 0.25 is estimated for this unit[17]. No in situ aquifer testing was performed during the site investigation on any

of the major aquifers present beneath the Plant because ground water is not intended to be employed for Plant use. However, based on the grain size distribution present in the surface sand, a coefficient of storage of approximately 0.15 is expected[17].

Laboratory permeability tests were also performed on 13 samples of the clay strata (Unit b). The range of permeability for the clay zone is from 0.000286 to 1,656 ft/yr with an average bulk density of 121 lb/ft^3.

Due to their depth below the surface and the presence of the thick, essentially impermeable, silty clay (Units b and c) beneath the entire Plant, no field or laboratory testing was performed on either the confined drift aquifer or the bedrock aquifers.

2.4.7.2.3 Water Quality

Groundwater quality from the drift aquifers in the Plant area is good except for a few wells in which iron concentrations exceed the limits recommended by the US Public Health Service. Saline water is commonly encountered in the bedrock in the Plant area. Table 2.4-11 shows the results of water chemistry analyses of samples taken during the site investigation. The location of each sampling point is shown in Figure 2.4-10. Diagrams of the groundwater chemistry are presented in Figure 2.4-11 (with the exceptions of DC-3 and DC-4 for which the listed constituents were not determined)

2 | Groundwater quality data collected during the Applicant's preoperational
12 | monitoring program (refer to Section 6.1.2.2.3) are shown in Table 2.4-12 and Figure 2.4-12.

2.4.7.2.4 Cation Exchange Capacities

The cation exchange capacities of four selected samples of soil from the Plant site were determined. Two samples were obtained from the surface sand and two were taken from the underlying clay. The surface sand yielded values of 1.5 and 2.2 me/100gm and the underlying clay yielded 15.1 and 26.0 me/100gm.

2.4.7.2.5 Groundwater Level Fluctuations and Recharge

Recharge of the surface sand present over much of the Plant site is by direct infiltration of precipitation. Groundwater levels in this sand are directly dependent on local short-term conditions. Local precipitation increases have an immediate impact on groundwater levels present in the surface material, as will flooding by the nearby Tittabawassee River. The confined drift aquifer present beneath the Plant site is covered by essentially impermeable clay over
2 110 feet thick. The confined aquifer is, therefore, not recharged in the Plant area (refer to Section 2.4.7.1.2).

The nearest long-term subsurface hydrologic data station in the drift is located in Gratiot County about 25 miles southwest of the Plant. Groundwater level records from this municipal water well in drift materials are inconclusive due to fluctuations related to pumping rates.

No long-term hydrographic data are available for the bedrock aquifers in Midland County. Due to their depth below the surface and limited usage in the site area, little variation of existing water levels is expected to occur during the life of the Plant.

2.4.7.2.6 Reversibility of Flow Patterns

No ground water will be used by the Midland Plant during operation and no industrial or municipal user is present in the Plant vicinity. Because of the relatively small yields obtained from water wells in the area, no future municipal or industrial development of this source is anticipated. Therefore, no potential for possible reversal of groundwater flow patterns due to either Plant or other use is anticipated.

2.4.7.2.7 Potential Seepage Effects from Onsite Cooling Pond

All relatively thin surface sand deposits along the cooling pond dike axes were removed and backfilled with impervious clay fill to prevent any seepage from the cooling pond into the surface sand outside the reservoir boundaries. In isolated areas where the surficial sand deposits were so thick that removal was deemed impractical, a trench was constructed in the bottom of the open excavation to the top of the clay. The trench was backfilled with a bentonite slurry which acts as an impervious cut-off wall. The underlying impermeable clays (Units b and c) are expected to prevent possible downward seepage from the cooling pond from reaching the confined drift or bedrock aquifers.

Section 6.1.2 discusses the groundwater monitoring program.

TABLE 2.4-12 1 of 2

RESULTS OF WELL WATER SAMPLING AND ANALYSIS CONDUCTED IN 1979[a]

Parameter	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10
M-Alkalinity (mg/l)	546.9	327.6	252.2	[illegible]47.9	196.9	263.0	36.2	147.5	314.0	32.3
P-Alkalinity (mg/l)	-	-	5.0	-	-	-	590.0	13.5	-	555.5
Bicarbonate (mg/l)	(c)	320.0	240.0	230.0	190.0	(c)	(c)	(c)	295.0	3.7
Calcium (mg/l)	133.4	29.27	19.10	37.2	17.73	194.1	18.40	18.50	77.7	31.70
Carbonate (mg/l)	(c)	7.2	14.1	(c)	3.1	(c)	(c)	(c)	1.5	580.0
Chloride (mg/l)	96.6	5.4	63.2	59.6	62.1	971.5	395.6	599.0	54.3	58.9
Flouride (mg/l)	0.5	0.4	0.3	0.4	0.1	0.1	0.8	0.6	0.6	0.4
Iron (mg/l)	1.72	0.58	7.08	0.90	1.38	1.77	0.45	0.09	2.46	0.10
Magnesium (mg/l)	868.7	24.4	13.2	287.0	10.5	885.5	1.0	1[illegible].1	676.0	10.2
Nitrate (mg/l)	0.3	0.34	0.05	0.1	0.03	0.8	0.07	0.04	0.4	0.19
pH (units)	7.22	8.30	8.63	7.64	8.[illegible]8	7.56	12.20	8.99	7.59	12.10
Phosphorus (T) (mg/l)	0.26	0.06	0.60	0.09	0.041	0.16	0.17	0.06	0.20	1.1
Potassium (mg/l)	31.90	4.96	10.73	5.54	1.52	29.58	31.18	12.80	4.12	29.07
Sodium (mg/l)	40.2	22.3	64.5	33.9	51.7	171.9	21.2	21.7	19.8	81.0
Specific Conductance @ 25°C	2157	596	610	763	576	4075	4347	2312	1311	3141
Sulfate (mg/l)	710	10	28	60	22	373	10	26	421	13
Total Dissolved Solids (mg/l)	1640	336	342	410	333	2164	1346	1161	831	759
Total Hardness (mg/l $CaCO_3$)	3909	17	102	1274	87	4129	50	104	2976	80
Total Organic Carbon (mg/l)	9	11	16	6	11	7	19	7	9	14
Total Suspended Solids (mg/l)	84	36	350	44	116	[illegible]	35	19	164	138
Anal Temperature (°C)	16.0	20.3	16.7	16.4	16.6	19.9	16.0	16.5	16.5	19.6

TABLE 2.4-12 2 of 2

RESULTS OF WELL WATER SAMPLING AND ANALYSIS CONDUCTED IN 1979[a]

Parameter	Well 11	Well 12	Well 13	Well 14	Well 15	Well 16	Well 17	Well 18[b]	Well 20	P2 (11 Oct 79)
M-Alkalinity (mg/l)	206.3	47.5	133.1	183.5	201.0	395.4	226.8	271.5	168.2	120
P-Alkalinity (mg/l)	-	141.0	98.6	-	-	-	-		2.2	NA
Bicarbonate (mg/l)	195.0	7.4	54.5	175.0	190.0	360.0	210.0	260.0	160.0	NA
Calcium (mg/l)	17.0	1.06	3.42	20.8	22.33	60.7	20.73	15.00	11.63	29.63
Carbonate (mg/l)	1.7	175.0	170.0	1.0	2.3	1.1	3.0	7.6	4.8	NA
Chloride (mg/l)	62.6	42.8	135.6	5.0	-6.4	11.8	35.3	32.1	20.3	68.5
Flouride (mg/l)	0.8	0.6	0.4	0.6	0.2	0.9	0.3	0.4	<0.1	NA
Iron (mg/l)	0.23	0.09	0.16	1.01	0.18	0.52	0.32	8.59	1.28	NA
Magnesium (mg/l)	151.2	3.2	12.2	150.0	10.1	417.2	13.1	10.4	8.4	228.3
Nitrate (mg/l)	0.1	0.08	0.05	0.2	<0.01	0.2	0.13	0.01	<0.01	0.02
pH (units)	7.88	11.34	10.40	7.77	8.01	7.42	8.08	8.30	8.42	8.16
Phosphorus (T) (mg/l)	0.05	0.08	0.10	0.15	0.06	0.05	0.25	-	0.02	<0.02
Potassium (mg/l)	4.46	14.13	165.88	22.06	2.00	3.25	2.54	8.77	2.42	4.27
Sodium (mg/l)	56.9	59.2	89.9	19.8	15.8	25.5	41.7	41.6	37.7	16.0
Specific Conductance @ 25°C	592	1051	1015	304	383	959	556	401	403	565.9
Sulfate (mg/l)	43	31	21	36	10	147	15	30	20[d]	40.0
Total Dissolved Solids (mg/l)	344	303	511	174	220	546	304	238	221	358
Total Hardness (mg/l $CaCO_3$)	664	16	59	669	98	1869	106	80	65	NA
Total Organic Carbon (mg/l)	8	23	12	8	27	8	14	52	17	NA
Total Suspended Solids (mg/l)	18	71	20	167	10	45	20[d]	642[d]	57	<4
Anal Temperature (°C)	16.9	19.2	20.6	16.2	19.9	15.5	19.5	19 3	19.6	11.9

(a)Based on Applicant's groundwater quality monitoring program as reported in LMS, 1980[16a].
(b)High suspended solids.
(c)Total filtered residue - off scale.
(d)Mean.

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17. D K Todd, Groundwater Hydrology, J Wiley & Sons, 1959, p 24.

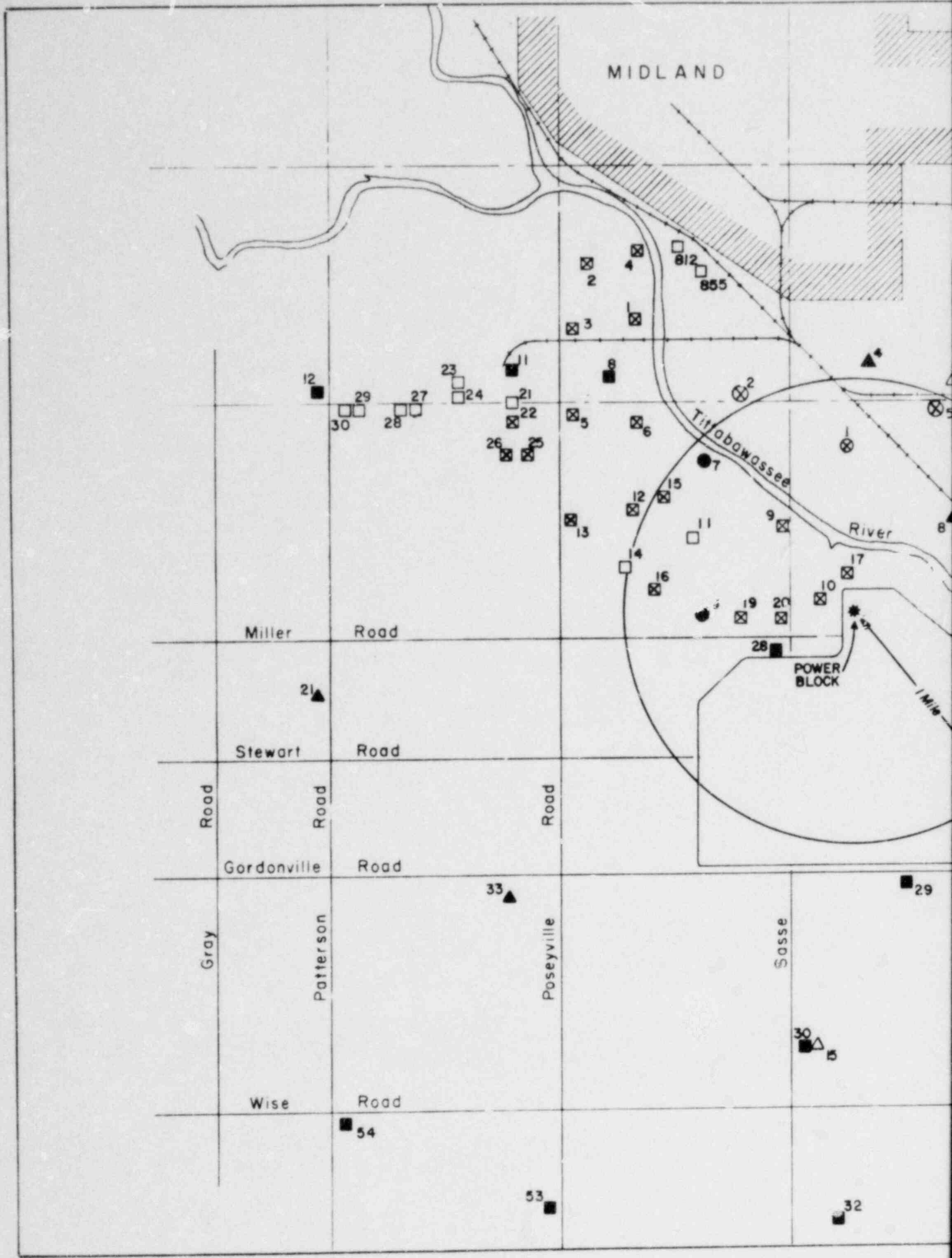
TABLE 2.5-1

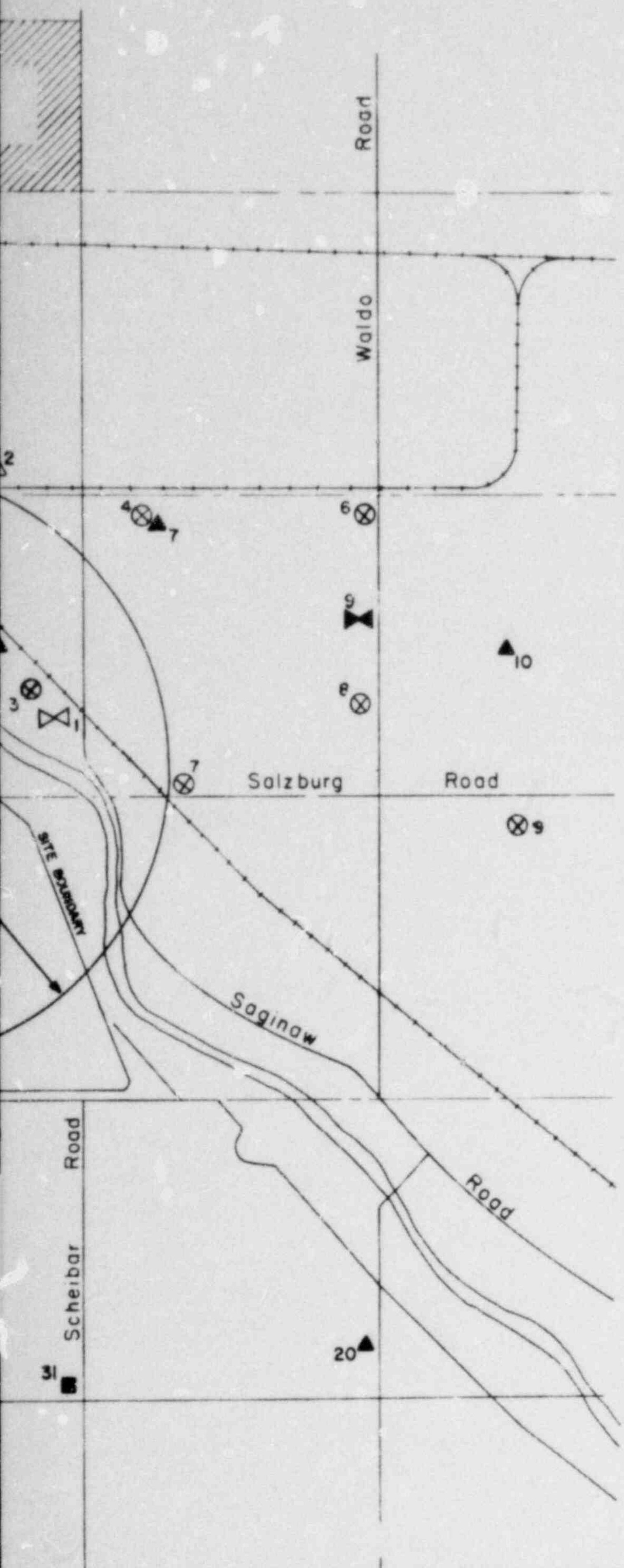
STATUS OF SALT, BRINE, AND INJECTION WELLS WITHIN ONE MILE OF THE MIDLAND PLANT[a]

	Well Number[b]	Symbol[b]	Total Salt Extracted (10^3 tons)	Current Status	Comments
				Salt Wells	
	9	⊠	372	Plugged in 1972	No production since 1964
	10	⊠	325	Plugged in 1968	No production since 1961
	11	□	450	Standby since 1971	
	14	□	523	Standby since 1970	
	15	⊠	555	Plugged in 1973	No production since 1969
	16	⊠	375	Plugged in 1979	No production since 1969
	17	⊠	607	Plugged in 1973	No production since 1970
	19	⊠	274	Plugged in 1973	No production since 1968
	20	⊠	354	Plugged in 1973	No production since 1967
	7	●	494	Operating	Originally drilled for use as a salt well; no salt has been extracted since 1970; now used for solid waste disposal in gallery with Well 18. To be plugged and abandoned in 1981.
12	18	●	426	Operating	Originally drilled for use as a salt well; no salt has been extracted since 1972; now used for solid waste disposal in gallery with Well 7. To be plugged and abandoned in 1981.
				Brine Wells	
	1	⊗	-	Plugged in 1973	No production since 1970
	3	⊗	-	Plugged in 1977	No production since 1970
	5	⊗	-	Plugged in 1977	No production since 1971
	28	■	-	Operating	
				Injection Wells	
	1	⋈	-	Plugged in 1979	No production since 1972
	8	▲	-	Operating	

(a) Status of wells based on latest available data received from Dow Chemical Company in June 1981.

(b) See Figure 2.5-5.


MIDLAND
Tittabawassee River
POWER BLOCK
1 Mile
Miller Road
Stewart Road
Gordonville Road
Wise Road
Gray Road
Patterson Road
Poseyville Road
Sasse



EXPLANATION

Salt Wells –

- ☐ Operational and Standby
- ⊠ Plugged and Abandoned.
- ● Solid Injection Wells Operational and Standby

Brine Wells –

- ■ Operational and Standby
- ⊗ Plugged and Abandoned

Injection Wells –

Brine injection well in:

Dundee Formation

- △ Operational and Standby
- ⋈ Plugged and Abandoned

Sylvania Formation

- ▲ Operational and Standby
- ⧓ Plugged and Abandoned

REFERENCE

Evaluation Of Subsidence Consumers Power Company, Midland Nuclear Power Plant, Units I and 2, (March, 1970) General Analytics, Inc. Monroeville, Pennsylvania, p.9 (15)

NOTES:

1. The status and location of wells is based on information received from Dow Chemical Company in May 1977 and updated in Sept. 1980 and June 1981.
2. The June 1981 update confirmed that all wells within the one mile radius are shown on this map.
3. In June 1981 it was determined that only selected wells were shown outside the one mile radius. The wells shown were updated to current status.
4. No additional wells have been drilled in the one mile radius since 1970.

0 ½ 1
Scale in Miles

0 ½ 1
Scale in Kilometers

FIGURE 2.5-5

SALT WELL LOCATION MAP

MIDLAND PLANT UNITS 1& 2

CONSUMERS POWER COMPANY

REVISION 12 – JUNE 1981

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CHAPTER 3

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The office and service building is sided with precast panels and curtain glass panels. This building, located on the west side of the turbine building, will be the focal point for Plant visitors.

The evaporator building, warehouse, combination shop, circulating water intake structure, change house, and administration building are located on the periphery of the main power block area. These buildings are covered with siding material similar in profile to the siding used for the turbine and auxiliary buildings to maintain continuity throughout the design.

3.1.2.2 Overall Plant Appearance

The overall Plant appearance has been unified through the following:

a. The protected area where the power block is located is surrounded by water creating an island-like effect.

b. The basic materials used are siding and concrete, minimizing small detail and concentrating on massing and proportions among structures.

c. Variations in colors have been minimized except for those required to provide contrast and to help blend the overall Plant appearance with the surroundings.

The siding color is light green for some buildings and dark green for others. These colors emphasize the importance of some buildings and reduce the impact of a great mass of one single color. This approach blends the power block with its surroundings.

3.1.2.3 Landscaping

Landscaping of the Midland Plant is provided for screening, aesthetics, naturalizing, zoning commitments and fog barriers. The landscaping plan is shown in Figure 3.1-5 and has been approved by the Midland Township Zoning Board of Appeals[1].

A continuous row of mixed tree plantings is used for screening purposes and for fog interception along Gordonville Road. The group plantings randomly spaced in the foreground are included to abate the monotony of a continuous-row planting. This same principle also applies in softening the impact of the elevated dike in the southeast corner of the cooling pond.

The west property line is planted chiefly for screening the pond from residential areas. The stock used in this section is closely related to our native trees. This gives the area a natural appearance, keeping it in harmony with the existing woodlots.

The entrance driveway is planted for aesthetic reasons and for softening the impact of the elevated dike in this area. The large trees also serve as a foreground for the Plant area, thereby assisting in reducing visual impact of the structures as viewed from the west.

12

TABLE 3.6-2 2 of 2

4. Magnetic Filter Backwash to Cooling Pond (Prior to Settling)

	Parameter	Value[c]
	Average daily volume, gal	400
	Maximum daily volume, gal	4,400
	pH	6.5-9.5
	TDS, mg/l	<50
7	TSS, mg/l	<1,500
	Oil and Grease, mg/l	<15
7	NH_3, mg/l	<2

5. Treated Oily Waste Treatment Discharge

	Parameter	Avg/Max Value	Limitations[a] Average/Maximum
1	Daily volume, gal	64,000/288,000	
	Maximum Firewater Usage Event, gal	218,000	
7	pH	6.5-9.5	6.0-9.0
8	TDS, mg/l	880/2,200	
	TSS, mg/l	<30/ <100	30/100
	Oil and Grease, mg/l	<15/ <20	15/20
7	NH_3, mg/l	<2	

6. Auxiliary Boiler Blowdown to Evaporator Building Neutralization Sump

	Parameter	Value[c]	Limitations[a] Average/Maximum
	Frequency, days per year per boiler	35	
	Average daily volume for both during operation, gal	1,900	
7	Maximum daily volume for both during operation, gal	19,000	
	pH	6.5-9.5	6.0-9.0
	TDS, mg/l	<20	
	TSS, mg/l	<30	30/100
	Fe, mg/l	<1[d]	1/1
	Cu, mg/l	<1[d]	1/1
	Oil and Grease, mg/l	<15	15/20
7	NH_3, mg/l	<2	

(a) 40 CFR 423.15 limitations for new sources.

7 (b) Makeup demineralizer and condensate polisher regeneration wastes are not expected to vary significantly from the average values presented.

(c) Values for concentration parameters are estimated maximums.

(d) During the start-up of an auxiliary boiler, total iron and copper concentrations in the boiler blowdown may exceed 1 mg/l for a few hours.

1 gallon = 3.79 liters.

TABLE 3.6-3

EXPECTED TITTABAWASSEE RIVER WATER QUALITY AT THE MIDLAND PLANT RIVER INTAKE STRUCTURE[a]

	Parameter	Average	Maximum	Minimum
	pH	8.40	8.60	8.15
	TDS, mg/l[b]	395	510	274
	TSS, mg/l[b]	13.3	47.4	1.5
	Ca, mg/l	28.29	37.22	24.11
	Na, mg/l	10.16	19.30	4.68
	Mg, mg/l[b]	18.8	22.6	12.8
	Cl, mg/l	61.9	94.3	24.8
	SO_4, mg/l	57	120	36
	PO_4, mg/l as P	0.06	0.11	<0.02
	Zn, mg/l	0.02	0.05	<0.01
12	NH_3, mg/l	0.04	0.06	0.02
	Conductivity, μmhos/cm	584	862	408
	DO, mg/l	9.5	10.7	8.5
	Turbidity, NTU	11	17	6
	Alkalinity, mg/l	168	176	161
	BOD, mg/l	2.09	3.00	0.80
	K, mg/l	2.34	4.20	1.46
	NO_3, mg/l	0.29	0.90	0.02
	NO_2, mg/l	0.01	0.02	<0.01

---

7 (a)Based on Applicant's water quality monitoring program (ER Section 6.1.1.1) for 1979, Intake Sampling Locations A_1, A_2 and A_3.

12 (b)Based on the Applicant's water quality monitoring program for 1978 at intake locations A_1, A_2 and A_3 as reported by Lenon, et al, 1978[2].

3.6R REFERENCES

1. Bechtel Associates Professional Corporation, Final Report - Midland Power
9 Plant - Cooling Pond Operation Study (March 1979), Report prepared for Consumers Power Company.

2. H L Lenon, et al, Survey and Evaluation of the Water Quality,
12 Tittabawassee River, near Midland, Michigan, 1978-1979 (April 1979), Report prepared for Consumers Power Company.

	Year	Natural Gas Consumption ($ft^3 \times 10^6$)
4		
	1982	270
12	1983	993
	1984	808
	1985 and thereafter	0-231

Note: A theoretically conservative scenario based on the simultaneous outage of both nuclear units for two months during the winter heating months results in the natural gas consumption of 231 $ft^3 \times 10^6$.

Each boiler at full load produces 150,000 lb/hr of saturated steam at 250 psig at the discharge header with a natural gas consumption of approximately
4 187,400 ft^3/hr. No treatment of the gaseous effluent is provided. The estimated yearly quantity of SO_2 gaseous effluent for both boilers using the maximum anticipated fuel sulfur content is as follows:

Natural Gas Consumption	993 $ft^3 \times 10^6$/yr (1980)	231 $ft^3 \times 10^6$/yr (1982, theoretical outage)
Total SO_2	29 tons/yr	7 tons/yr

Note: 1 ton = 907 kg

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3.7.2 Liquid Effluents

3.7.2.1 Laundry Waste

The laundry waste consists of personnel decontamination solutions, emergency shower water, and liquid waste generated from washing clothing which is potentially contaminated with radioactive particulates. This waste contains detergents and is not processed through demineralizers or evaporators, but is filtered for gross solids removal and collected in the laundry drain tank where the radioactivity level is monitored. Under normal conditions, laundry waste does not require treatment for radioactive contamination. From this drain tank the waste is filtered again for fine solids removal and released through the discharge structure to the Tittabawassee River. If the radioactivity level exceeds discharge limits, the waste will be diverted to the liquid waste system evaporator for processing as discussed in Section 3.5.2.

The quantity of laundry waste for the Midland Plant is estimated at a daily output of between 450 and 600 gallons. A non-phosphate synthetic detergent is used that allows the Plant to meet the NPDES Permit requirements for discharges to the Tittabawassee River.

3.7.2.2 Storm Drainage

The storm drainage system collects precipitation runoff from most of the building roofs and areaways, paved and unpaved surfaces of the power block area, and conveys the water to the cooling pond. The drainage from the evaporator building, combination shop, and part of the service water cooling

tower area is discharged directly into the Tittabawassee River via drainage ditches.

Precipitation falling on areas which may be contaminated by oil is collected and treated in the oily waste system (refer to Section 3.6).

3.7.2.3 Sanitary Waste

The sanitary waste collection system provides for sewage collection and the
11 conveyance of these wastes and the blowdown and continuous sample flow from
the process steam evaporators to The Dow Chemical Company Waste Treatment
Plant. The system consists of a gravity sewer which collects the effluent
from all building sanitary plumbing systems. The sewage, evaporator blowdown
11 and continuous sample flow are pumped by a sewage lift station to Dow via
12 force main.

Administrative control, design, and restricted access to contaminated areas are provided to prevent radioactive materials from entering the domestic sanitary waste water collection system.

The maximum expected load during Plant operation is based on a population of 600 at 50 gallons per capita per day or 30,000 gallons per day.

12 The Dow treatment facility consists of pH control, primary settling, organic
removal in aerated sludge basins and secondary settling. Effluent
equalization occurs in the tertiary pond. The facility is under continuous
licensed supervision.

3.7.2.4 Laboratory Wastes

All laboratory waste drainages are routed as follows:

a. The dirty radwaste system collects laboratory and other wastes which contain potentially radioactive substances.

b. The detergent radwaste system collects laboratory and other wastes which can contain detergent and radioactive substances.

c. The turbine building laboratory wastes are routed to the turbine
11 building neutralizing sump.

d. The evaporator building laboratory wastes are routed to the evaporator building neutralizing sump.

The dirty radwaste and detergent radwaste systems are discussed in Section 3.5.2. Neutralizing sumps are discussed in Section 3.6.

3.7.3 Solid Waste

Solid waste includes trash, garbage, and other solid materials, such as materials from the trash racks and water screens in the water intake structures. These solid wastes are removed to a sanitary landfill by a licensed waste disposal company as discussed in Section 5.6.3. The estimated quantities of such wastes are presented in Table 5.6-2.

3.8 RADIOACTIVE MATERIAL MOVEMENT

12| Transportation of fuel and waste to and from the Midland Plant is within the scope of 10 CFR 51.20(g). Therefore, the environmental impact of transportation of radioactive material and the risks from accidents involving this transportation are those set forth in Summary Table S-4 of 10 CFR 51. The assumptions upon which Table S-4 of 10 CFR 51 are based are compared to
12| Midland Plant operations in Table 3.8-1.

TABLE 3.8-1

COMPARISON OF TABLE S-4 ASSUMPTIONS VS MIDLAND STATION OPERATIONS

10 CFR 51.20	MIDLAND STATION
(i) The reactor is a light water-cooled nuclear power reactor with a core thermal power level not exceeding 3,800 megawatts;	(i) The reactors are light water-cooled nuclear power reactors, each with a core thermal power level of 2,452 MW and each capable of an ultimate core thermal power level of 2,552 MW (Ref FES Section III.C).
(ii) The reactor fuel is in the form of sintered uranium dioxide pellets encapsulated in zircaloy rods with a uranium 235 enrichment not exceeding 4 percent by weight;	(ii) The reactor fuel is in the form of sintered uranium dioxide pellets encapsulated in zircaloy rods with a U-235 enrichment of 2.3 to 2.64 percent by weight (Ref FES Section III.E).
(iii) The average level of irradiation of the irradiated fuel from the reactor does not exceed 33,000 megawatt days per metric ton and no irradiated fuel assembly is shipped until at least 90 days have elapsed after the final assembly was discharged from the reactor;	(iii) The average level of irradiation of the irradiated fuel from each reactor will be about 28,000 megawatt days per metric ton and no irradiated fuel assembly will be shipped until at least 90 days have elapsed after the final assembly is discharged from the reactor.
(iv) Waste (other than irradiated fuel) shipped from the reactor is in the form of packaged solid wastes; and	(iv) Waste (other than irradiated fuel) will be shipped from the station in the form of packaged, solid wastes; and
(v) Unirradiated fuel is shipped to the reactor by truck; irradiated fuel is shipped from the reactor by truck, rail or barge; and waste other than irradiated fuel is shipped from the reactor by truck or rail.	(v) Unirradiated fuel will be shipped to the station by truck; irradiated fuel and other wastes will be shipped from the station by truck or rail.

3.9 TRANSMISSION FACILITIES

3.9.1 Implementation of Environmental Guidelines

Guidelines based on recommendations from Federal publications[1,2] were
utilized by Consumers Power Company personnel for selecting substation
sites[3] and transmission line routes[4] for the Midland Plant. A consultant
12 in landscape architecture prepared the guidelines. Modified tree clearing
policies were adopted at that time to preserve a maximum of vegetative cover.
These policies were later augmented by recommendations from the Michigan
Department of Natural Resources (MDNR)[5].

The aforementioned guidelines regarding the environmental impact of transmis-
sion facilities have been implemented to the extent practicable. Some
12 recommendations were inapplicable to specific situations. The rights of
individual landowners were taken into account. Governmental restrictions,
such as zoning ordinances and aviation airspace restrictions, further inhibit
implementation of individual guidelines. All factors, including economics,
were reconciled before selecting a substation site or transmission line route.

3.9.2 Regulations and Controls

The Michigan Public Service Commission (MPSC) requires conformance to all requirements of MPSC Order 1679[6], coordination with all other utilities and approval of all other permits before approving a construction permit. In addition to coordination with other utilities to provide adequate clearances, mitigating action was taken where required to reduce electric interference to communication lines. MPSC Order 1679 is an adaptation, with minor revisions,

of the 1973 Edition of the National Electrical Safety Code[7]. All materials' strength, clearance and other safety requirements were exceeded in the design
12 of all Plant-related transmission facilities. The requirements of the 1981 revision of the National Electrical Safety Code were also met. Additional strength was provided to anticipate possible icing due to fog from the Midland Plant cooling pond. Design conductor loading, based on MPSC Order 1679, requires provision for 1/2 inch (1.27 cm) radial ice with a 40-mile per hour (64.37-km per hour) transverse wind pressure plus a constant of 0.31 pound per conductor foot (4.61 grams/cm). Actual design loading will provide for 1-1/4 inch (3.18-cm) radial ice with an 18-mile per hour (28.97-km per hour) transverse wind pressure on all transmission lines in the area influenced by the cooling pond. This represents an 83.3% increase in vertical loading and a 65% increase in the resultant of transverse and vertical loading on the structures due to conductor loading.

12 Permits are required for railroad, highway and county road crossings. The US Corps of Engineers requires a permit under Section 10 of the Rivers and Harbors Act for all transmission line crossings over the Tittabawassee River.
12 Similar permits are required from the Michigan Department of Natural Resources (MDNR) under Inland Lakes and Streams Act, PA 346 of 1972, for the Bad River and Beaver Creek as well as the Tittabawassee River. The US Corps of Engineers also requires a permit under Section 404 of the Federal Water Pollution Control Act. Similar permits are required from the MDNR under the
12 Soil Erosion and Sedimentation Control Act, PA 347 of 1972. None of the

12 rivers in the project area are listed under the Michigan Natural Rivers Act, PA 231 of 1970.

Notification and approval are required from the Tri-City Joint Airport Zoning
9 Board. Tri-City Airport is over 5 miles (8.05 km) from the nearest project transmission line.

There is no known zoning ordinance in conflict with construction plans.

1

3.9.3 Land Usage

The Midland project area is part of the Saginaw Glacial Lake Plain. The terrain is very flat with alluvial clays and fine sandy soils. The Tittabawassee River flows southeast through Midland to join the Shiawassee/Saginaw River south of Saginaw (see Figures 3.9-1, 3.9-2 and 3.9-3A). The Bad River (North and South Branch), Potato, Beaver, Wolf and Swan Creeks and numerous drains converge on the Shiawassee River near St Charles (see Figures 3.9-3C, 3.9-3F and 3.9-3G).

The small villages of Brant, Nelson, Hemlock and Mapleton are the only communities other than Midland that are within one mile (1.61 km) of the transmission lines. Land usage is predominantly agricultural with most farms at least 80 to 160 acres (32 to 65 ha) in size. The dominant crops are corn and navy beans. The area south of Midland is intensively cultivated and nearly treeless. Brant Township in Saginaw County is intersected by a number of creeks and rivers and associated wetlands with a large percentage of early successional stage vegetation[8,9]. The Gratiot-Saginaw State Game Area is located west of Brant Township. The Shiawassee River State Game Area is

located east of Brant and Fremont Townships. Both game areas are shown on Figure 3.9-1. The only other recreational facilities in the area are the Brant Rifle and Pistol Club in the NE 1/4 of Section 10, Brant Township, Saginaw County and the Maple Hill Golf Course 3 miles (4.83 km) east of Hemlock in the NE 1/4, Section 25, Richland Township, Saginaw County. Fraser Airport and Sonefield Agency Airport, shown on Figure 3.9-1, are the two airfields nearest to Plant project transmission facilities.

3.9.4 Environmental Assessment

3.9.4.1 Terminal Points

The two 345 kV bus tie lines between the Midland Plant Units and Tittabawassee Substation terminate on the south turbine building wall. The two 138 kV start-up lines terminate on independent steel structures located east of the turbine building.

All Plant-related transmission lines terminate at the existing Tittabawassee Substation located 1.4 miles (2.25 km) east-southeast of the Midland Plant. The apparent size of the 14-acre (5.67-ha) low-profile substation is reduced by a setback of approximately 1,250 feet (381 m) east from Waldo Road and 500 feet (152.4 m) south from Milner Road (see Figure 3.9-4). The setback also effectively attenuates any equipment generated noise. Vehicles associated with maintenance and inspection of the substation are parked onsite away from public roads. This 80-acre (32.4-ha) substation site is adjacent to
12 undeveloped industrial property of The Dow Chemical Company. The substation property is level and nearly treeless formerly cultivated land as indicated on Figures 3.9-4 and 3.9-2. The overall dimensions of Tittabawassee Substation

were not altered by the addition of the Plant-related lines. The impact of the substation changes on the surrounding area is minimal.

The point of interconnection with the integrated electric system is on the existing undeveloped Gary Road Substation site in the NE 1/4, Section 3, Brady Township, Saginaw County. This 108-acre (43.7-ha) site is partially wooded and isolated from houses. The wooded portion of the site is in the early stages of hardwood forest succession[8,9]. Charred stumps on the site are evidence of a past fire. Tree and shrub cover[10,11] ranges from 20 to 100% with heights of 15 to 40 feet (4.57 to 12.2 m). The larger trees appear to be remnants that survived the fire. Young sapling growth is dominated by trembling aspen (Populus tremuloides), red maple (Acer rubrum) and white birch (Betula papyrifera). Shrubs are quite dense in wetter areas where alders dominate. There are also isolated occurrences of sphagnum moss. Soils on the site are sandy and of little agricultural value. Since the area is in an early successional sere, it is ideal for wildlife food and cover.

3.9.4.2 Midland 138 kV Start-Up Lines

Two independent sources of preferred power to the Class 1E ac systems are required to permit functioning of structures, systems and components important to safety at the Midland Plant in accordance with the requirements of 10 CFR 50, General Design Criteria 17. Separate line routes were selected for each
12| start-up line based on these criteria. Details of the transmission line facilities are given on Table 3.9-1.

The initial start-up line connects to the terminal structure for the start-up transformer and extends approximately 950 feet (290 m) to tap an existing

circuit at a tower on the Plant site (see Figure 3.9-2). An intermediate single circuit, lattice steel, type TM tower is required (see Figure 3.9-5). The impact of the initial start-up line is insignificant because the area involved is small and it is used for material storage, railroads, roadways and utilities.

The second start-up line connects to the terminal structure for the second start-up transformer and extends to a single circuit, lattice steel, type TH tower (see Figure 3.9-5) located east of the dike utilizing intermediate wood poles. The tower is required to provide for a change in conductor tension and direction. The line then crosses under two 345 kV lines and over a roadway and railroad spur to a self-supporting steel pole located on the pond side of the dike berm. The remainder of the line south to Gordonville Road along or adjacent to the dike is constructed with single wood pole, davit arm structures (see Figure 3.9-6). A section of future double circuit tower line
12 (see Figure 3.9-7) scheduled for the Tittabawassee-Bullock 138 kV line was prebuilt between a point on Gordonville Road and Tittabawassee Substation and utilized for the start-up line. This tower line crosses a Dow pipeline and railway easement. The line will be temporarily connected to the Tittabawassee-Begole line at the Tittabawassee terminal tower. The line, including the 1.0 mile (1.61 km) section of prebuilt tower line, is 2.7 miles (4.35 km) long. The environmental effects of this line are discussed in detail in Section 4.2 of the Environmental Report Supplement (ERS)[12]. These line routes are shown on Figure 3.9-2.

3.9.4.3 Midland 1 and 2 to Tittabawassee 345 kV Lines

Two 345 kV bus tie lines originate at the south turbine building wall of the Midland Plant and extend across the north pond area with structures located adjacent to the dikes (Figure 3.9-2). Single circuit towers shown on Figure
12 3.9-8 were utilized for these lines. The lines parallel an existing 138 kV tower line on 100-foot (30.5-m) centers along the toe of the dike to a point southerly of the railroad bridge. The lines cross the Tittabawassee River and South Saginaw Road along the south side of Salzburg Road. Vegetation along the riverbank was not disturbed. A small woodlot between the river and the dike was cleared. The area under the lines between South Saginaw Road and the railroad is used for industrial settling ponds. The remainder of the route
12 along the northeasterly side of the railroad right-of-way was constructed over an area partially developed for industrial landfill. Both lines will be 2.3
11 miles (3.7 km) long. The environmental effects of this line are discussed in the Applicant's Supplemental Environmental Report (ASER)[13] and the Final Environmental Statement (FES)[14].

3.9.4.4 Tittabawassee to Kenowa/Thetford 345 kV Line

The Tittabawassee-Kenowa/Thetford 345 kV line was also addressed briefly in the ASER[13] and the FES[14]. A more detailed analysis follows.

The Tittabawassee to Kenowa/Thetford line is located in an existing corridor that was purchased prior to 1972. Double circuit towers, shown on Figure 3.9-9, were utilized. The corridor, excluding the wider, 1 mile (1.6 km) long exit at Tittabawassee, will accommodate two 345 kV tower lines. The first 8.0 miles (12.9 km) south from the Tittabawassee exit also accommodates two 138 kV

tower lines and the next 7.6 miles (12.2 km) accommodates one 138 kV tower line. A 138 kV line was built in the north 8.0 miles (12.9 km) of the corridor in 1972. The 345 kV line is located 100 feet (30.5 m) east of the existing 138 kV line. The relative location of lines and the width of the corridor are indicated on Figures 3.9-2 and 3.9-3A through 3.9-3H.

The transmission line crosses numerous drains and creeks in addition to the Tittabawassee River and both forks of the Bad River. The Tittabawassee flood plain in the area of the proposed river crossing is approximately 0.5 mile (0.8 km) wide. Two structures are located in the low area northerly of the river with one of the towers placed within 200 feet (61 m) of the riverbank to provide clearance enough to allow riverbank vegetation to remain undisturbed. The tower on the southerly side of the crossing is placed at the top of an embankment to allow all except the largest trees to remain. Other river and creek banks are left undisturbed except for the removal of larger trees. The majority of the land along the route is cultivated. Wooded areas are generally a composite of immature trees, saplings and shrubs. Nearly 60% of the route lies along property lines. The alignment was adjusted in several locations to avoid the removal of residences. The 345 kV line utilizes 333 acres (135 ha) of the 1,050 acres (425 ha) acquired for the existing corridor, a reduction of 167 acres (68 ha) over that required for a separate strip.

The length of the line is 27.3 miles (43.9 km). The average area disturbed
for installation of each set of tower anchors is a 40-foot (12.2 m) square. A
12 total of 153 towers required for the entire line causes the disturbance of 5.6
acres (2.3 ha) of land, exclusive of any compaction by construction vehicles
along the tower centerline.

A summary of land types and vegetation types along the Tittabawassee-
Kenowa/Thetford 345 kV line route is shown on Table 3.9-2 and identified on
12 Figures 3.9-3A through 3.9-3H. Most of the better agricultural land is
located just south of the Midland Plant site. About 66% of the land crossed
is classified as good to excellent cropland (A1 and A2). Nearly all of the
right-of-way crosses ancient glacial lake beds of clays, silts and sands with
flat terrain that provides some of the most fertile soils in Michigan. Poorer
soils (A3) are found on the sandy glacial lake shorelines that meander through
the area.

Although 273.8 acres (110.8 ha) of agricultural land are occupied by the
12 right-of-way for this line, only 3.6 acres (1.5 ha) will be taken out of
production based on plow clearance around all towers in cultivated fields. It
is not unusual for some crops to be planted between the tower legs. A total
12 of 88 towers (58%) are located in presently cultivated fields. A lease-back
arrangement allows the adjacent landowner to continue cultivation of the land
under the transmission lines.

True upland forests do not exist because the entire area can be classified as
lowland. The differentiation of lowland and upland hardwoods in Table 3.9-2
is arbitrary. Lowland forests indicated are those bordering streams and
rivers. Forested lands comprise 20% of the total right-of-way and other
12 natural vegetation accounts for an additional 6%.

In general, the lowland hardwoods[8,9] are comprised of silver maple (Acer saccharinum), ashes (Fraxinus spp.), willows (Salix spp.), cottonwood (Populus deltoides) and bur oak (Quercus macrocarpa) in the tree stratum. Other tree species commonly found on lowlands are trembling aspen (Populus tremuloides),

white birch (Betula papyrifera), red maple (Acer rubrum), box elder (Acer negundo) and basswood (Tilia americana). The latter five species are also found in the areas defined as upland in this assessment along with white oak (Quercus alba), black oak (Q. velutina), red oak (Q. rubra) and white ash (Fraxinus americana). Tree heights along the line route vary from tracts of immature trees of 30 feet (9.1 m) to mature trees in several tracts of up to 90 feet (27.4 m). The sapling and shrub category includes areas which have revegetated with 3- to 5-inch (7.6 to 12.7 cm) diameter - breast high, 15- to 30-foot (4.6 to 9.1 m) shrub and tree species. All areas not under cultivation and not included in the woodland, sapling/shrub or miscellaneous categories, such as roadway and waterways, are considered old field.

Most conifer types along the line route are pine and spruce plantations and they vary from 6 to 40 feet (1.8 to 12.2 m) in height. White pine (Pinus strobus) may be found occasionally scattered among upland hardwoods and on sandy ancient glacial lake shorelines.

The Applicant's 1979 ecological survey[14a] describes Plant community formulas for 112 segments of forest or other naturally vegetated Plant communities on the line route. The formulas supply data on cover type, species, relative abundance or dominance by stratum, density and, where applicable, diameter breast height (dbh) and tree height.

12 This survey also provides data on the distribution and abundance of both flora and fauna along the line route With respect to the latter, detailed information was gathered on the distribution and relative abundance of mammals, birds, reptiles and amphibians in correlation with vegetation on the line route. The survey emphasized "important" species as defined by NRC

Regulatory Guides 4.2, Section 2.2 "Ecology". The survey concluded that
12 impacts of line clearing, construction and maintenance on the local flora and
fauna would be minor.

A total of 14 agricultural drainage ditches and 5 streams are crossed by the
line route. These crossing widths vary from 4 to 300 feet (1.2 to 91.4 m) and
12 include the Tittabawassee River and North and South Branches of the Bad River.
Agricultural drainage ditches have been channelized and generally have little natural vegetation. All waterways are small enough to be readily spanned with sufficient clearance and setback of structures so that vegetation, except for occasional large trees, can be left undisturbed.

Dr John Halsey, State Archaeologist, Michigan History Division, has reviewed plans for the transmission line routes and he has indicated that the area contains a concentration of archaeological sites. In response to his request, Dr Christopher Peebles, Curator of the Museum of Anthropology, University of Michigan, was contracted to conduct a field survey. Dr Doreen Ozker, Survey Archaeologist, identified 25 sites of varying significance which were reported in detail (refer to Appendix 2.6C). The sites date from 2000 BC (late Archaic) on into the historic period. Remains of Indian campsites were found on minor sandy prominences that remained from beach lines and dunes formed by ancient glacial lakes. The dry elevations above the marsh and wet prairies that replaced the glacial lakes were ideal campsites. Transported fire-cracked rock, stone tools and weapons were found at these locations but no potsherds were found. The sites indicated are small or extend in a narrow strip (beach line) in an east-west direction across the line right-of-way so that no conflict problem exists with towers spaced approximately 1,000 feet

(304.8 m) apart. A discussion of the avoidance and mitigation plan to
4 minimize the impact on the discovered archaeological sites along the
transmission line route is included in Section 4.2.2.

3.9.5 Railroad and Highway Crossings

The Chesapeake and Ohio Railway serving Saginaw and Midland crosses diagonally through the southwest corner of the Tittabawassee Substation site. The two 345 kV bus tie lines between the substation and the Midland Plant parallel the railroad, then cross at a point south of Salzburg Road. The second 138 kV start-up line crosses the railway on the substation site. All lines on the Midland Plant site cross the Plant railway spur. The Tittabawassee to Kenowa/Thetford 345 kV line crosses the railway north of South Saginaw Road. This line also crosses the Chesapeake and Ohio Railroad System serving Saginaw and Alma at a point southeast of Hemlock.

The Tittabawassee to Kenowa/Thetford line crosses M-46 east of Hemlock. The highway is a low traffic volume, two lane, paved road connecting Saginaw and Alma. All project lines from Tittabawassee Substation cross South Saginaw Road, an important local road which connects the south end of Midland with M-47 and the Saginaw area. The line also crosses various county roads, generally at 1-mile (1.6-km) intervals as indicated on Figures 3.9-3A through 3.9-3H.

3.9.6 Environmental Effects of Electrical Fields

3.9.6.1 General

The electrical effects of 138 kV transmission lines are not significant for
the conductor sizes and line designs utilized for the Midland start-up lines.
The discussion is therefore directed toward the Midland 1 and 2 to
Tittabawassee and Tittabawassee to Kenowa/Thetford 345 kV lines. The latter
line is of an improved design with greater clearances and larger conductors
than used for most of the existing 345 kV system. This results in a
corresponding reduction of any electrical effects. Statements related to
experience are based on 1,864 circuit miles (3000 km) of 345 kV lines in
12 operation since 1968 and prior to 1981.

3.9.6.2 Electrostatic and Electromagnetic Induction Effects

Line-to-ground clearances beneath 345 kV lines are sufficient to limit the
charging current to 5 milliamperes or less from vehicles normally expected to
be under the line. Electrostatically induced currents from stationary objects
12 on or near the right-of-way are minimal and only six complaints due to
electrostatic induction effects on the entire Consumers Power Company 345 kV
system have been received to date. All complaints which have been received
were thoroughly investigated and have been resolved by some method of
grounding.

12 The 1981 Edition of the National Electrical Safety Code(7), Rules 232 Blc, 232
C2c and 232 D3c, limits the current due to electrostatic effects to 5
milliamperes if the largest anticipated truck vehicle, or equipment under the
line, is short-circuited to ground. MPSC Order 1679(6) (which applies in

Michigan) has not to date been revised to include a provision to limit current due to electrostatic effects. This requirement, however, has been considered as part of the line design criteria.

3.9.6.3 Radio and Television Interference

The level of radio and television interference emanating from 345 kV lines is minimal. However, it is difficult and impractical to completely eliminate radio and television interference. Any interference complaints that are received are thoroughly investigated. If it is found that the interference is caused by the transmission line, corrective action such as antenna relocation or replacement is recommended.

Guidelines for acceptable radio reception are given in a Federal Communications Commission Report[15].

3.9.6.4 Audible Noise

Fair weather audible noise from 345 kV lines is practically nonexistent. During foul weather, audible noise levels increase but are below annoyance levels. No audible noise complaints have been received to date.

Federal[16] and State[17] Occupational Noise Exposure Regulations control harmful noise levels of 90 dB(A) and above. The maximum audible noise from a 345 kV line is substantially below this level.

3.9.6.5 Ozone Production

All Extra High Voltage transmission line ozone measuring programs have indicated that 345 kV lines do not generate ozone levels measurably higher

than the ambient level near the line under any weather conditions. There is no environmental impact due to ozone production from 345 kV lines associated with the Midland Plant.

Guidelines are provided by the US Department of Health, Education and Welfare for limitation of photochemical oxidants[18].

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above mean sea level (msl). To minimize the effects of dredging, the following measures were taken:

a. Construction of a cofferdam to prevent runoff and erosion during the construction of the intake structure and retaining walls.

b. Dumping of dredge spoils onshore.

c. The placement of riprap along the banks for minimizing erosion and siltation.

All riprap was sound, durable rocks, free of cracks, and coverage size of 8 to 12 inches (20 to 30 cm) with specified maximum and minimum sizes of 18 and 6 inches (43 and 15 cm), respectively.

d. Finished surfaces around the intake structure were smoothed to conform to the general contour of the floodplain. Finished surfaces and embankments were seeded, fertilized and mulched to prevent soil erosion.

Benthic macroinvertebrates inhabiting this area were found in concentrations ranging from 54 to 1,595 per m^2, both prior to and following dredging. Much of the variability in collections was due to the constant shifting of bottom
12 substrates in the river[4]. The unstable sandy river bottom is unfavorable for infaunal macroinvertebrate tala[5]. Benthic organisms inhabitating the area were removed with the spoil, but the modification did not affect the assimilative capacity or the water quality and biological productivity potential of the river. The downstream effects of increased suspended solids,
12 fine particulates, and siltation was minimal since the benthic commmunity is

not well established and is most likely sustained by continued colonization from upstream populations[5].

The effects of dredging on fish populations of the area were not apparent and
12 were most likely limited to temporary displacement of some individuals. CMU found a healthy fishery during 1977[4] and 1978[6] monitoring. The net result of dredging, from a fisheries standpoint, is an improvement of the stream due to deepening, bank stabilization and cover.

4.1.4 Other Impacts of Site Preparation and Station Construction

Socioeconomic impacts are discussed in Chapter 8.

Impacts associated with transmission facilities have been addressed in Section 3.9.

Two previously identified archeologically significant sites which contain
6 historic and prehistoric artifacts were identified in a 1978 survey on the Tittabawassee River floodplain (refer to Section 2.6.2). Archeological sites along transmission corridors have been addressed in Section 3.9 and described in Appendix 2.6C.

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12

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4.2 TRANSMISSION FACILITIES CONSTRUCTION

Transmission lines associated with the Midland Nuclear Plant construction
consist of two 345 kV lines running 2.3 miles (3.7 km) to Tittabawassee
12 Substation and one 345 kV line running 27.3 miles (43.9 km) from Tittabawassee
Substation to interconnect with the existing Kenowa-Thetford 345 kV line. The
line route between the Plant and the substation crosses flat land identified
12 as industrial or wasteland. The 27.3-mile (43.9 km) section of line running
south out of the substation crosses farmlands mixed with occasional woodlots.

Another line associated with the project is a 138 kV start-up line running
south along the east side of the cooling pond and east along the north side of
Gordonville Road. This line crosses the Tittabawassee River and Saginaw Road
approximately 1 mile (1.6 km) south of the 345 kV line crossings and then
continues northeast into Tittabawassee Substation. The clearing at the river
is for construction access with a majority of the right-of-way selectively
12 cleared to preserve low growing species. Trees along Saginaw Road obstruct
views to the line at the crossing location.

12 Routing of the 138 kV start-up line and the two 345 kV lines utilized existing
vegetation. An insignificant amount of clearing was required between the
Midland Plant and Tittabawassee Substation. The Tittabawassee to Kenowa-
12 Thetford 345 kV line required clearing only 110.9 acres (45 ha) of scattered
fencerows and woodlots at a width of 142 feet (43.3 m). Additional trees
12 outside the cleared right-of-way which endangered the line were also removed.

The most visually sensitive area affected by new transmission lines is the
northern one-third of the Tittabawassee to Kenowa-Thetford right-of-way[1].
12 In this area, the flat terrain has little arborescent vegetation. This area

12 is cultivated up to roadsides and ditch banks. The predominance of row crops also has eliminated fencerows and the vegetation that usually is present along fencerows. Although the transmission towers are exposed for long distances, the rural nature of the surrounding area reduces the effects of this exposure.

The remaining portion of the Tittabawassee to Kenowa-Thetford 345 kV line route has a moderate sensitivity. In some areas the line will be screened by existing woodlots and stream valleys.

Design, routing, construction and maintenance of these transmission lines is done in accordance with Environmental Criteria for Electric Transmission Systems[2] developed by the US Departments of Interior and Agriculture, and Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities[3] published by the Federal Power Commission. In addition, the Applicant has engaged landscape architects to develop guidelines[4] for minimizing impact of transmission lines and facilities on aesthetic values. These criteria have been applied in design of the transmission lines from the Midland Plant to the substation, and from the substation to the Kenowa-Thetford line.

11 Approval of the Corps of Engineers was obtained for erecting the transmission lines across the Tittabawassee River, Bad River and Beaver Creek.

4.2.1 Clearing Techniques and Changes to Physical and Biological Processes

12 Construction clearing practices of selective cutting, minimizing the width of the cleared strip, clearing to a variable width within spans and preserving of existing small trees and shrubs were followed when possible to reduce visual

impact. Merchantable timber was salvaged and slash windrowed or disposed of.
12 Windrowing provides habitat for many species of birds and mammals and is a
method accepted by the Michigan Department of Natural Resources.

12 Construction activities along the transmission line route required removal of
4 all trees and brush to at least 45 feet (13.6 m) on either side of the tower
center line. Additional trees tall enough to endanger the reliability of the
12 operating line were removed up to 115 feet (34.7 m) from the tower center
line. Clearing activities began on September 10, 1979 on the southern end of
the right-of-way. This date coincided with completion of field work for the
ecological survey on this segment of the right-of-way. The ecological survey
for the entire right-of-way, which was completed on September 14, 1979,
10 revealed no threatened or endangered species or other significant impediments
to construction. Clearing activities were completed by November 15, 1979.
Clearing crews were transported in small pickup trucks. Small crawler type
tractors windrowed brush along the right-of-way.

In wooded areas that required clearing, the physical structure of the forest
12 as well as the biotic succession was reduced to herbaceous ground cover.
These conditions are the results of clearing the corridor, grading where
required for a construction road in the right-of-way, grading and excavating
12 for tower bases, constructing of towers, and moving heavy equipment across the
terrain.

12 The cleared wooded areas were changed structurally and compositionally from
areas supporting at least three vegetative strata and wildlife nesting areas
to areas of one or two vegetative strata. While floral and faunal species
10 requiring a forest habitat in this stage of succession have been negatively

10 impacted, floral and faunal species favoring earlier successional stages will be benefitted. Important game species such as deer, rabbits, and grouse
12 should benefit from the construction and maintenance of this right-of-way. Topographical and hydrological changes are minimal due to lack of significant relief in this area. Hence, disruption of drainage patterns or topographical features by line construction has a negligible effect on biological processes.

4.2.2 <u>Erecting Towers and Stringing Conductors</u>

12 Constructing of towers and stringing conductors will cause minor disruption to the environment. At each tower, work activities involve travel across the shortest and most practical access roads. Work activities which impact the
4 right-of-way for the Tittabawassee to Kenowa/Thetford transmission line
12 follow, based on the current construction schedule.

11 Shipments of tower anchor steel were delivered to railhead storage sites by
10 November 1979. Contractor's equipment will be set up and excavation for tower
11 foundations is scheduled to begin in August 1982. Heavy tracked equipment or
10 truck-mounted power augers will be required to bore four-foot diameter holes to depths from 10 feet (3 m) to 20 feet (6 m) depending on soil conditions. A 30-foot (9 m) long, trailer-mounted, vibra-hammer, towed by a truck or
12 tractor, will be required to drive caissons for the foundation at each of the
4 four tower legs. A stump-free access road to each tangent tower site will be required for the front-end dump, 12-1/2 yard concrete trucks to supply concrete for the pier type foundations. A tracked front-end loader and a soil
12 compactor will be used at each angle tower to excavate and cover the 12 to 15 foot (3.7 to 4.6 m) square reinforced concrete pads for the four tower
4 anchors. A 15-man crew transported by light trucks will be used at each tower

4 site. With allowance for inclement weather and unusual access problems,
12 foundation work will progress ahead of tower erection crews to a scheduled
completion date of August 1983.
11

Tower steel delivery is scheduled to begin by August 1982 by 10-ton multi-
12 wheeled trucks from the storage site to the tower sites and will continue as
10 required, except for the period when spring load restrictions are placed on
12 roads. Approximately 2,100 tons of tower steel or an average of 14 tons per
4 tower will be required. Sorting and partial assembly of tower steel will be
done by a 15-man crew. A 70-ton, self-propelled, tracked crane, supported by
10
a 12-man crew, is scheduled for delivery to start erection of towers on
completed foundations by November 1982. Tower erection is scheduled for
11
completion by May 1983.

Conductor reels are usually placed at four-mile intervals with tensioner
equipment located at the midpoint between them. Conductor stringing
4 operations start approximately one month after tower erection starts. A light
caterpillar tractor will be used to pull the lead line along the approximate
tower center line between the conductor reels and the tensioner. Conductors
are tension strung so that they do not touch the ground. Two reels of
10 conductor per phase are pulled from each direction and joined with splices
before the equipment is moved to the next station where the process is
4 repeated The heavy equipment along with the caterpillar tractors used for
transportation and anchorage are located as near to roadways as practical.
12 Wire installation is scheduled to begin in January 1983 and to be completed by
11 July 1983.

11 Project completion is scheduled for August 1, 1983. Two weeks are allowed for
10 testing of substation equipment prior to the service date. Site cleanup,
12 grounding and fence restoration should be completed before October 1, 1983.

The Tittabawassee to Kenowa/Thetford 345 kV line route crosses 14 agricultural drainage ditches and 5 streams(1). Most of the drainage ditches are small and lack arborescent vegetation; therefore, transmission line construction does not create much impact. Construction equipment generally uses existing roads and culverts in crossing ditches to prevent erosion and siltation.

All stream and river crossings will be accomplished in accordance with
10 specifications that are conditions for permit approvals by the Michigan Department of Natural Resources under the Inland Lakes and Streams Act, Act 346 of Public Acts of 1972 and by the Corps of Engineers under Section 404 of
11 the Federal Water Pollution Control Act (PL 92-500 as amended).

The 25 archeological/historic sites reported (Appendix 2.6C) along the Tittabawassee to Kenowa/Thetford 345 kV transmission line route can, in general, be avoided and left intact on the right-of-way. An avoidance and
4 mitigation plan was finalized at a Consumers Power meeting with Dr Doreen Ozker, Archeologist for the Great Lakes Museum of Anthropology, University of Michigan, and Dr John Halsey, State Archeologist, on November 29, 1978. This plan is summarized on Table 4.2-1.

11 Five of the archeological sites were removed from consideration because prior
4 sand removal and grading by others had destroyed the archeological materials
12 or because they were not archeological sites in the right-of-way. Eleven of
4 the archeological sites can be avoided because their locations are such that

4 they can be posted to direct construction activities around them. Tower
locations will be adjusted to span the archeological sites.

10 Nine of the archeological sites required mitigation because they conflicted
4 with line construction plans for structure location or access along the right-
of-way. Phase I field reconnaissance of all these archeological sites was
10 conducted in the spring of 1979. This phase of archeological mitigation
11 involved plowing, surface collection of artifacts and shovel probing to
determine whether the site was significant enough to require detailed Phase II
mitigation. Phase I reconnaissance was generally restricted to the part of
10 the right-of-way impacted by construction activities. If the results were
negative, that area was then cleared for unrestricted construction activity.
Phase II excavation, conducted in the spring of 1979, involved plotting the
concentrations of artifacts recovered in Phase I, analysis of their
significance, division of the site into a grid for controlled surface
collection, and further excavation to the archeological horizon in areas that
11 were productive in Phase I. Phase III analysis involved documentation,
interpretation and reporting of the results of the mitigation activities. As
indicated in Section 2.6.3, a report has been provided to the NRC on the
findings of this analysis.

4 The Herber Site, 20SA318, located south of Ring Road in the southwest one-
10 quarter of Section 15, Brant Township, Saginaw County, involved Phase I, II
4 and III activities. The Big Mapleton Site, 20MD116, located in the floodplain
10 north of the Tittabawassee River in the southwest one-quarter of Section 1,
Ingersoll Township, Midland County, also required the same treatment. Phase
11 II excavation also occurred at other sites after the Phase I field
10 reconnaissance. Following archeological fieldwork completed in July 1979,

sites listed for mitigation were clear for unrestricted construction activity,
10 pending the September completion of the concurrent ecological study discussed in Section 4.2.1.

4.2.3 Access and Service Roads

During construction, access to the right-of-way generally is along established
10 farm lanes and temporary drives near the line. New access roads to the right-of-way are constructed only when absolutely necessary. New roads and temporary drives are returned to their original use upon completion of construction.

4.2.4 Erosion Due to Transmission Line Construction

Soil erosion is controlled in compliance with Michigan Soil Erosion and Sedimentation Control Act[5]. Temporary measures are implemented during construction to eliminate soil erosion associated with construction activities and the use of heavy equipment. Upon completion of construction, disturbed areas are regraded and permanent erosion control measures are administered to preserve the water quality of the watershed.

Construction activities on agricultural lands subject these areas to some wind erosion. Agriculture is extensively practiced close to roads, ditches and streams, leaving vast areas devoid of windbreaks and shelterbelts. During construction, this condition exists for one growing season. Following construction, the land again is available for agricultural practices. If winter wheat has been sown, there exists the possibility of losing two growing seasons.

4.2.5 Loss of Agricultural Productivity

Land usage is studied to develop the best possible route with the least interference to existing conditions. The largest land usage along the Tittabawassee to Kenowa-Thetford right-of-way is agriculture. Although the right-of-way is fee owned, more than 50% of the land has been leased back to the original owners. Where possible, the line is situated along existing land lines between land ownerships. Where the line crosses fields, land use is restricted only around the base of the tower. Nonleased lands are allowed to become established with indigenous vegetation and provide wildlife habitat.

One growing season, or possibly two, are lost on agricultural land during transmission line construction. This is a total of about 125 acres (50 ha) for the Tittabawassee to Kenowa-Thetford right-of-way if only a 15-foot (4.6 m) wide strip down the center of the corridor is considered to be lost for one growing season. Assuming that this land were all planted to dry beans, approximately 1,512 bushels (53 m^3) would be lost for that growing season. Dry beans account for about 37% of the land in agricultural production in the two counties, Midland and Saginaw, that the transmission lines cross[6].

4.2.6 Endangered Species Affected by Transmission Line Construction

The US Department of Interior's list of "Endangered and Threatened Wildlife and Plants"[7] and the Michigan Endangered and Threatened Species list[8]
12 published in 1976 and 1974, respectively, listed no plant or animal species that one might reasonably expect to be affected by Plant transmission lines. Since that time, the Michigan list has been expanded to include a number of plant and animal species, some of which might, on the basis of their historic

distributions or observations by the Applicant and his consultants, conceivably be impacted by the Plant and its facilities. Some plant species with historic local distributions are also being considered for Federal status. These species and their proposed status are included in the list, even though their official status is pending. Additionally, the Plant cooling pond attracts several species which were not considered in the original assessment of potential transmission line impact.

Table 4.2-2 lists endangered and threatened plant and animal species which might conceivably be impacted by the Plant or its transmission facilities. The list was originally developed in response to a question submitted on October 11, 1978 by the NRC; the table was formerly labeled END 1-1. This list will now be qualified on the bases of current Federal and State listings
12 and ecological data gathered between October 11, 1978 and the present.

First, terrestrial ecological survey of the transmission lines conducted in 1978-1979[9] failed to locate any of the listed plant species noted in Table 4.2-2. Intensive qualitative and quantitative sampling techniques were applied with an emphasis toward finding the endangered and threatened species listed in the table. None of these species were found, despite intensive sampling efforts.

One Michigan listed threatened bird species, the Marsh Hawk (Circus cyaneus), was seen during its fall migration on the transmission line route. Due to the small numbers involved and their transient status on the line route, the probability of impact to this species is extremely low.

No threatened or endangered mammal, reptile or amphibian species was encountered during the 1978-1979 ecological survey despite intensive sampling.

Applicant's properational monitoring studies[10,11] have shown that several Michigan-listed threatened and endangered bird species are attracted to the Plant cooling pond (Table 4.2-2). These include the Double-Crested Comorant (<u>Phalacrocorax</u> <u>auritus</u>), the Common Tern (<u>Sterna</u> <u>hirundo</u>) and the Caspian Tern (<u>Hydroprogne</u> <u>caspia</u>). While these species might conceivably be impacted by
12 striking transmission lines or other Plant facilities, no morbidity or mortality to these species has been recorded during two years of sampling. The extremely low morbidity and mortality rates suffered by abundant bird species as a result of striking transmission lines near the cooling pond[10,11] indicate that the impact to threatened and endangered bird species is probably negligible.

ENDANGERED AND THREATENED FLORA AND FAUNA OF THE SAGINAW, MIDLAND AND BAY COUNTIES AREA[a]

PLANTS[b]

Saginaw County

Carex platyphylla (Carey)
Threatened - Michigan

Sedge

Habitat: Rich deciduous woods and rocky slopes.
Late April - June.

Habenaria flava (L.)
Rare - Michigan; Threatened - US

Tubercled orchid

Habitat: Swampy woods, bottomlands.
June - September.
(No longer being considered for US "threatened" status.)

Habenaria leucophaea (Nutt.)
12 Threatened - Michigan, US

Prairie fringed orchid

Habitat: Wet prairie; open (tamarack) swamps; bogs.
Mid-June - August.

Trillium viride (Beck.)
Threatened - Michigan

Trillium

Habitat: Rich woods. April - May.

Midland County

Cypripedium arietinum (R. Br.)
Rare - Michigan; Threatened - US

Ram's-head lady's slipper

Habitat: Damp, mossy woods; bogs.
Late May - June.
(No longer being considered for US "threatened" status.)

Carex seorsa (Howe)
Threatened - Michigan

Sedge

Habitat: Wet woods; swamps.
April - early July.

Sisyrinchium atlanticum (Bickn.)
Threatened - Michigan

Blue-eyed grass

Habitat: Damp-dry meadows; marshes; low woods.
May - July.

Diarrhena americana (Beauv.)
Threatened - Michigan

Habitat: Shaded riverbanks and woods.
July - September.

Lindernia anagallidea (Michaux.)
Threatened - Michigan

False pimpernel

Habitat: Damp shores, sands.
June - October.

Bay County

Habenaria ciliaris
Threatened - Michigan

Orange fringed orchid

Habitat: Bogs or swamp sandy soil in woods, thickets, etc.

Habenaria leucophaea (Nutt.)
Threatened - Michigan, US

Prairie fringed orchid

Habitat: Wet prairie; open (tamarack) swamps; bogs.
Mid-June - August.

Beckmannia syzigachne (Steudel.) Fern
Threatened - Michigan

Slough grass

Habitat: Wet areas.

Stipa comata (Trin. & Rupr.)
Threatened - Michigan

Feathergrass, speargrass

Habitat: Dry soil.

Asclepias hirtella (Pennell) Woodson
Threatened - Michigan

Milkweed

Habitat: Open areas, prairies, fields, waste ground.

ANIMALS

MAMMALS

Synaptomys cooperi (Baird)
Threatened - Michigan

Southern bog lemming

Habitat: Moist, grassy areas; heavy grass cover.[c]

Microtus pinetorum (LeConte)
Threatened - Removed from 1979-1980 Michigan list in February 5, 1980 revision.

Pine vole

12 Habitat: Grassy areas at edges of woodlands; deciduous forests with thick layer of duff; orchards.[c]

BIRDS

Falco peregrinus (Tunstall)
Endangered - Michigan, US

Peregrine falcon

Habitat: Migrates south along beaches, hunts over wooded areas, open country and coastal areas; feeds on birds; migrant only.

Dendroica kirtlandii (Baird)
Endangered - Michigan, US

Kirtland's warbler

Habitat: Very specific nesting requirements which include dense young stands of jack pine on Grayling sand. Suitable nesting habitat is not found at the Midland site. May possibly see this bird as a migrant, but unlikely.

Phalacrocorax auritus (Lesson)
Endangered - Michigan list

Double-crested cormorant

Habitat: Inhabits areas with large bodies of water, where it feeds primarily on fish and crustaceans. Has been seen on Plant cooling pond.

Haliaeetus leucocephalus (L.)
Threatened - Michigan, US

Bald eagle

Habitat: Seldom found far from water (eg, lakes, large rivers, coastal areas). Large trees are used for nesting; food staple is fish. Feeding habitat may be found on or near Plant site. Nests in Saginaw County; no recent records of this species nesting in Bay or Midland Counties have been found.

Circus cyaneus (L.)
Threatened - Michigan

Marsh hawk

Habitat: Marshes, grassy swales and open fields are required for feeding on staple foods such as frogs, snakes, crayfish, large insects and some small birds. Low meadows and marshy areas are suitable for nesting sites, where shrubs and tall weedy growth afford concealment. Seen in migration on the transmission right-of-way.

Pandion haliaetus (L.)
Threatened - Michigan

Osprey

Habitat: Nests in areas with extensive bodies of clear water with elevated nest sites. Food staple is fish. No suitable nesting sites appear to exist in the study area. Observed during 1971 ecological survey, but not during 1979 or 1980 preoperational monitoring.

REPTILES AND AMPHIBIANS

Elaphe obsoleta (Say)
Threatened - Michigan

Black rat snake

Habitat: Habitat varies from rocky, timbered hillsides to flat farmlands and coastal plains. Woodlots and agricultural lands in the study area could provide habitat for this species.[c]

ANI[illegible]

MAMMALS	BIRDS		REPTILES AND AMPHIBIANS
	Sterna hirundo (L.) Endangered - 1979-1980 Michigan list Common tern Habitat: Great Lakes and over large inland lakes. Has been observed at Plant cooling pond.	Lanius ludovicianus (L.) Threatened - Michigan Loggerhead shrike Habitat: Inhabits open country with woody growth for nesting sites and lookout perches (eg, hedgerows, scattered trees, fence and utility poles and wires). Food consists of insects, some mice and birds. General habitat requirements are met throughout the Midland Plant area.(c)	
	Accipiter cooperi (Bonaparte) Threatened - Michigan Cooper's hawk Habitat: Perches in dense, leafy crowns, hunts birds and small mamals in open farmland. Favors scattered woodlots interspersed with open farmland for nesting. Has been seen near the Midland site.	Hydroprogne caspia (Pallas) Threatened - Michigan list Caspian tern Habitat: Found both coastally and inland. Robs other sea birds, eats eggs; fish is main diet. Has been observed at Plant cooling pond.	
	Buteo lineatus (Gmelin) Threatened - Michigan Red-shouldered hawk Habitat: Nests and feeds in and around swamps, river bottoms, and other wet woodlands, and is common in farming country in small woodlots, which provide acceptable (but not preferred) nest sites. Midland Plant area could provide nesting sites and food sources. Nests in Saginaw County; no recent records of this species nesting in Bay or Midland Counties have been found.		

12

(a)Endangered or threatened status in Michigan according to the February 5, 1980 revision of rules promulgated under Act 203, PA 1974. Plants no longer being considered for US listing are noted, the change in status having been published in the Federal Register Monday, December 15, 1980, pp 82480-82569.
(b)Occurrence based on historical records for the tri-county area.
(c)May be found in the tri-county area on the basis of habitat requirements.

4.2R REFERENCES

1. Environmental Services Department (compiler), Staff Field Surveys, (March 1977), Consumers Power Company.

2. US Departments of Interior and Agriculture (compiler), Environmental Criteria for Electric Transmission Systems, 0-404-932 (1970), US Govt Printing Office, Washington, DC.

3. Federal Power Commission (compiler), Guidelines for the Protection of Natural, Historic, Scenic and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities, Order 414, (November 27, 1970), Federal Power Commission.

4. Clarence Roy, Transmission and Distribution Rights-of-Way Selection and Development - Consumers Power Company, Johnson, Johnson & Roy, Inc, November 1970.

5. Michigan Department of Natural Resources (compiler), Michigan Soil Erosion and Sedimentation Control Act, Act No 347, Public Acts of 1972, State of Michigan

6. Statistical Reporting Service, Michigan Agricultural Statistics, 1970: 1969 Agricultural Census, Michigan Department of Agriculture.

7. US Department of Interior, "Endangered and Threatened Wildlife and Plants," Federal Register, Vol 41. No 191, September 30, 1976, pp 43340-43357.

8. Michigan Department of Natural Resources (compiler), *Endangered and Threatened Species,* Sect 4, Public Act No 203 of Public Acts 1974, State of Michigan.

9. Asplundh Environmental Services, *Terrestrial Ecological Survey for Midland Nuclear Plant - Tittabawassee Substation - Gary Road Substation 345 kV Transmission Right-of-Way for Consumers Power Company*, (November 1979).

10. Michigan State University, *Waterbird Use of the Midland Plant Cooling*
12 *Pond and Dow Chemical Company's Tertiary Treatment Pond - Annual Report - 1979* (1980).

11. Michigan State University, *Waterbird Use of the Midland Plant Cooling Pond and Dow Chemical Company's Tertiary Treatment Pond - Annual Report - 1980* (1981).

4.3 RESOURCES COMMITTED

Construction of the Midland Plant and associated transmission facilities requires the commitment or loss of some land, water, biota and material resources. These resources and the implications of their commitment or loss are discussed in the following sections.

4.3.1 Land Resources

4.3.1.1 Plant Site

The main power block, cooling pond, support facilities, laydown areas and transmission lines have, or will, utilize most of the land on site (1,235 acres, 500 ha). Of this 1,235 acres, approximately 880 acres (356 ha) are taken up by the cooling pond, 23 acres (9.3 ha) by the main power block and the rest by roads, railways, dikes, other structures and construction laydown.

All of the land on site is potentially irretrievable at least for uses that were practiced prior to Plant site development. All of the topsoil has been removed from the cooling pond and other areas; hence, a return of the land to agriculture or forest lands following decommissioning is not readily feasible. In addition, water in the cooling pond will have deposited high concentrations of dissolved solids in the subsoil, which would add to this land's future unavailability for agriculture or forest uses. Some land (about 200 acres, 81 ha) that is used for construction laydown and buffer zones will be landscaped or allowed to revegetate naturally.

The loss of the 1,235 acres (500 ha), which was about 50% agricultural land and 50% land in natural to semi-natural state, represents about 0.016% of the agricultural land and 0.028% of the land in a natural condition in the East

Central Michigan Planning and Development Region (ECMPDR)[1]. The ECMPDR includes 14 counties and more than 8,700 square miles (22,500 km^2) in the east-central portion of the Lower Peninsula of Michigan. Agriculture represents 61.3% or 3,446,080 acres (1,394,609 ha) of the total land area included in the ECMPDR and natural lands (forest and wetlands) include 35.7% or 2,004,640 acres (811,267 ha). The Midland Plant is located near the center of the ECMPDR.

The soils that made up the agricultural portion of the site were rated as highly productive; while soils occupied by natural vegetation were rated low in productivity.

4.3.1.2 Transmission Facilities Construction

Environmental assessment for transmission facilities is discussed in Section 3.9.4. A summary of the extent of utilization of land resources follows.

Tittabawassee Substation is an existing facility which will serve as an interconnection between the Midland Plant, Units 1&2 electric generating facilities and the Consumers Power Company integrated electric system. There will be no physical change in the 14-acre (5.7-ha) size of the fenced enclosure. Railroad right-of-way, including a 50-ft (15.2-m) wide spur to serve the substation, occupies 4.3 acres (1.7 ha). Existing public road and driveway right-of-way occupies an additional 3.0 acres (1.2 ha) of the substation site. The total earth disturbance on the substation site will be less than 0.4 acre (0.2 ha) due to construction of one 138 kV tower and five 345 kV towers and installation of four wood poles. It is assumed that the above land can be reclaimed for previous uses following decommissioning.

As stated in Section 3.9.4, towers will be located within an existing corridor between Tittabawassee Substation and the point of connection with the Kenowa-Thetford 345 kV Line. Towers will be located to avoid disturbance of archaeological sites identified by University of Michigan archaeologists
12 (refer to Appendix 2.6C). A total of 5.6 acres (2.3 ha) will be disturbed for construction of towers within the corridor. These 5.6 acres will be lost to existing uses for the duration of line operation. However, this commitment of land is not irretrievable.

Less than 0.4 acre (0.2 ha) will be disturbed by the towers required for the
12 128 kV Midland start-up circuits. One tower each will be located on public land (City of Midland, Saginaw Road-Waldo Road interchange) and Dow Chemical Company river frontage. The remaining towers and poles will be located on site or on Consumers Power Company land associated with the Tittabawassee Substation site.

Part of the Midland Plant 345 kV Line right-of-way will cross Dow Chemical Company lands. A major part of this right-of-way was formerly reserved for railroad sidings. Less than 1.0 acre (0.4 ha) of newly disturbed land will be added for tower construction since many towers will be located on fill established for Dow pond containment dikes.

The accumulative impact of construction activities for transmission facilities will be minor and temporary. For all transmission facilities associated with
12 the Midland Plant, less than 8 acres (3.2 ha) of land will be lost to present uses by construction of 190 towers and 16 wood poles.

4.3.2 Water Resources

Some commitment of water has been, and is, required during construction of the Plant but losses are negligible and result only in a redistribution of water resources. In addition to using the City of Midland water supply, water needed for construction purposes has been obtained from wells that were
12 drilled on site. Water for initial filling of the cooling pond was obtained from the Tittabawassee River in accordance with limits set forth in Table
6 3.4-6. The Tittabawassee River was dredged and widened by 100 feet (30.5 m) for approximately 2 miles (3.2 km) adjacent to the Plant to compensate for the floodplain that was lost due to the construction of the Plant and cooling pond (see Section 4.1.3).

4.3.3 Biotic Resources

Irretrievable loss of aquatic biota during construction has been addressed in
12 Section 4.1.3 and in the FES[2] and RS[3].

Irretrievable loss of terrestrial biota during construction has been addressed
12 in Section 4.1.1, and in the ASER[4] and ERS[3]. It is assumed that the majority of wildlife and vegetation have been displaced and/or destroyed in the construction area of 1,235 acres (500 ha).

4.3.4 Material Resources

4.3.4.1 Plant Construction Materials

Concrete and steel constitute the bulk of materials used for construction of the Midland Plant, but many other material resources are also incorporated into the physical Plant.

Although materials used for construction of the Plant are mostly depletable resources, some of the materials are of sufficient value that their recovery at the end of the Plant life may be desirable. However, radioactive contamination of a portion of these materials may not permit recovery. Some materials inside the containment will be directly exposed to neutron radiation and will become radioactive. Other materials not exposed to neutron radiation can be decontaminated and recovery is feasible. The materials used in Plant construction which may not be amenable to decontamination and reuse constitute a small fraction of the available material resources.

Construction materials are generally expected to remain in use for the full life of the Plant. There will be a substantial period of time before terminal disposition must be decided. At that time, materials that are precious metals, strategic and critical materials, or materials having small natural reserves will be considered individually and plans will be made to recover and recycle as much of these material resources as is feasible.

4.3.4.2 Transmission Line Construction

The basic commitment of material resources for transmission facilities consists of galvanized structural steel for towers and substation structures, concrete for foundations, and conductor and switchgear for the substation.

While the external dimensions of Tittabawassee Substation will be unchanged, it will be necessary to add nine 345 kV air circuit breakers, twelve 345 kV disconnect switches, 2.7 metric tons of aluminum bus, 125.2 metric tons of galvanized structural steel and 595 cubic yards (455 m^3) of foundation concrete. In addition, an appropriate amount of hardware and porcelain insulators and bushings will be required.

A total of 32.1 miles (51.7 km) of 345 kV tower line and 2.9 miles (4.6 km) of
combined 138 kV pole and tower line is required for the transmission lines
12 associated with the Midland Plant. A total of 2,635 metric tons of galvanized
tower steel will be required as well as 590 cubic yards (451 m^3) of concrete
for foundations. In addition, 16 wood poles of 70- to 90-foot (21- to 27-m)
length will be required. A total of 1,793,405 feet (546,631 m) of 1,431 kcmil
ACSR (45/19), weighing 1,318 metric tons, will be required. A total of 84,015
feet (25,608 m) of 2,156 kcmil ACSR (84/19), weighing 96 metric tons, will
also be required. In addition, 30,221 feet (9,211 m) of 336.4 kcmil ACSR
(26/7), weighing 6.3 metric tons, will be required to complete the
12 transmission lines. An estimated 21,860 insulator units will be required,
along with appropriate hardware, to attach conductors to the 199 poles and
towers.

4.3R REFERENCES

1. The Chester Engineers (compiler), Assessment of Current Water Quality Conditions and Factors Responsible for Those Conditions (draft), Chapter 3, Section C (July 1976), East Central Michigan Planning and Development Region, pp 19-21.

12 2. Division of Radiological and Environmental Protection (compiler), Final Environmental Statement Related to the Construction of Midland Plant Units 1&2, Consumers Power Company, Section IV-B and C, (March 1972), US Atomic Energy Commission.

3. Consumers Power Company (compiler), Midland Plant Units 1&2, Environmental Report Supplement (as amended), Section 4.1 (October 26, 1976), Consumers Power Company.

12 4. Consumers Power Company (compiler), Midland Plant Units 1&2, Applicant's Supplemental Environmental Report (as amended), Section 4.1 (October 19, 1971), Consumers Power Company.

CHAPTER 5

TABLE OF CONTENTS

5 ENVIRONMENTAL EFFECTS OF PLANT OPERATION

5.1 EFFECTS OF OPERATION OF HEAT DISSIPATION SYSTEM

Throughout this Section temperature is given in English units as it is stated in the corresponding standard or regulation. For conversion of temperature to metric units, the following formula may be used: °C = 5 (°F - 32)/9.

5.1.1 Effluent Limitations and Water Quality Standards

5.1.1.1 State

The State of Michigan has not promulgated specific effluent limitations or guidelines governing point source wastewater discharges to receiving waters.
12 However, Rule 323.2137 of the Michigan Administrative Code (Michigan Water Resources Commission General Rules, Part 21) provides that conditions of National Pollutant Discharge Elimination System (NPDES) permits issued by the MWRC shall be adequate to insure compliance with effluent limitations
12 promulgated by the US Environmental Protection Agency (EPA) and shall include such other more stringent limitations necessary to meet applicable State water quality standards (refer to Appendix 5.1A). As a result, this rule incorporates by reference the federal effluent limitations discussed in Section 5.1.1.2.

State water quality standards for Michigan surface waters of the State of
12 Michigan were adopted by Michigan on November 13, 1973 and approved by the EPA on November 26, 1973. These standards are contained in the Michigan Administrative Code as Rules 323.1041-323.1116 (Michigan Water Resources Commission General Rules, Part 4, refer to Appendix 5.1A). These water quality standards establish water quality requirements for Michigan's surface

waters that will protect the public health and welfare, enhance and maintain water quality and protect the quality of waters for selected uses.

As part of the water quality standards, the MWRC has established certain designated uses for waters of the State. All waters are protected for their designated use while waters with multiple designated uses are protected by the limitations of the most restrictive use. The designated uses for the lower Lake Huron Basin are identified in Rules 323.1100-323.1115. As a minimum, all waters of the State are protected for agricultural uses, navigation,
12 industrial water supply, public water supply at the point of water intake, warmwater fish and partial body contact recreation. Certain waters that are designated as trout streams by the Director of the Department of Natural Resources are protected for coldwater fish. In addition, selected impoundment and portions of streams as well as inland lakes are protected for total body contact recreational use.

The remaining rules in the Water Quality Standards are established to protect the designated uses identified in Rules 323.100-323.115.

Rules 323.1069-.1082 of these State standards establish heat load limitations for receiving water bodies, which vary depending on the designation of the water body. The Tittabawassee River has been designated as a river capable of supporting warmwater fish; discharges to such streams must not raise the natural temperature of the river more than 5°F in the surface one meter at the
12 edge of a mixing zone established by the MWRC. It is specified that the points of temperature measurement normally shall be in the surface one meter. Monthly maximum temperatures in °F at the edge of the mixing zone for streams capable of supporting warmwater fish are also specified as follows:

J	F	M	A	M	J	J	A	S	O	N	D
41	40	50	63	76	84	85	85	79	68	55	43

The above standards are based on the 90th percentile of occurrence of natural water temperatures, plus the increase allowed at the edge of the mixing zone, and, in part, on long-term physiological needs of fish. When natural water temperatures exceed the 90th percentile occurrence, the monthly maximum temperatures may be exceeded for short periods. Temperature increases during these periods may be permitted by the MWRC, but in all cases shall not be
12 greater than the natural water temperature plus the increase allowed at the edge of the mixing zone.

Rule 323.1051 states that Total Dissolved Solids (TDS) in the waters of the State (outside of the mixing zone) shall not exceed a concentration of 500 mg/l as a monthly average nor more than 750 mg/l at any time as a result of discharge at controllable point sources. Other water quality limitations are also included in the standards, but expected discharges from the Midland Plant are not significant in the context of the limits designated.

5.1.1.2 Federal

Federal effluent guidelines for steam-electric power generating point sources are published in 40 CFR 423. Effluent guidelines applicable to the Midland
12 Plant are found in 40 CFR Sections 423.12-.14 (refer to Appendix 5.1A). Pursuant to the decision in Appalachian Power v Train, 545 F.2d 1351 (1976), subsections 423.12(a), 423.13(1) and 423.13(m) have been set aside and remanded to EPA for further consideration. Section 423.12 established effluent limitations which must be achieved by July 1, 1977. These limitations represent the degree of effluent reductions achievable with the

application of "best practicable control technology currently available." Section 423.13 establishes effluent limitations which must be achieved by July 1, 1983. These limitations represent the degree of effluent reductions achievable with the application of "best available technology economically achievable." Plant design has taken into consideration the effluent limitations set forth in both Sections 423.12 and 423.13.

The limited discharge from the Midland Plant to the Tittabawassee River will not affect the quality of water in any other state or states.

5.1.1.3 License Conditions

In addition to the effluent guidelines and thermal standards described above, Consumers Power Company has also agreed to other license conditions as required in the Midland Final Environmental Statement[1] as follows:

7. The conclusion is that the benefits to be derived from operation of the Midland Plant Units 1 and 2 outweigh the adverse effects identified in this statement. On the basis of the evaluation and analysis set forth in this Final Statement, and after weighing the environmental, economic, technical, and other benefits against environmental costs and considering available alternatives, it is concluded that from the standpoint of environmental effects the action called for is the issuance of a construction permit for the Midland Plant Units 1 and 2, provided the applicant takes the following additional actions:

    a. Modify the cooling water intake structure design to allow a reduction of the intake flow velocity to less than one foot per second to minimize fish loss (see Section V, Page 16).

    b. Relocate the 138 kV transmission line from the Dow South Substation so as to utilize the same river crossing as the 345 kV lines (see Section V, Page 8).

    c. At least two years prior to Plant operations, initiate an ecological (including radiological)

study of the site and environs to establish base line values. The study should have a scope and frequency which will:

1. Identify the economically and environmentally important species, determine their abundance and life history when pertinent to the site, and define the extent and location of their habitat;

2. Characterize the ecological community, defining the community structure with special attention to stability or fluctuations; and

3. Obtain background data on the radioactivity in important indicator organisms (see Section V, Pages 13, 21 and 33).

d. Develop a surveillance and monitoring program of significant parameters based upon the ecological study which will document the impact of the Plant operations upon the ecology of the site and environs. The ecological surveillance and monitoring program actions to be developed should serve to identify actual effects on the environment from Plant operations (see Section V, Pages 13, 21 and 33).

e. Growths of nuisance algae in the pond must be controlled. If biocides are used, the pond blowdown must be suspended during the interval necessary for biocide degradation to acceptable discharge standards (see Section V, Page 17).

f. Prevent any discharge which would result in increasing the phosphorus concentration in the river above 0.05 ppm (see Section V, Pages 18 and 20).

g. In order to assure that the chlorine residual in the river is negligible, the concentration in the pond blowdown must be limited to 0.05 ppm (see Section V, Page 18, and Section V, Page 20).

Only four of the seven license conditions (requirements 7(a), (b), (c) and (d)) were incorporated in the construction Permits No CPPR-81 and CPPR-82 issued December 15, 1972 by the Atomic Energy Commission (AEC)[2]. The remaining three license conditions (7(e), (f) and (g)) relate to operation of the facility.

5.1.1.3.1 Chlorine

Recommendations 7(e) and (g) are directly related to each other as the biocide considered for control of nuisance algae in the pond is chlorine. Federal effluent guidelines for free available chlorine are published in 40 CFR, Section 423.12. These guidelines limit the maximum free available chlorine concentration discharged to 0.5 mg/l and the average free available chlorine concentration to 0.2 mg/l.

The MWRC Rules contain no chlorine standards or limitations. Rather, Rule 323.1082 establishes "a mixing zone to achieve a mixture of a point source discharge with the receiving waters . . ." This Rule also provides "as a minimum restriction the toxic substance 96 hour TL_m for important species of fish or fishfood organisms shall not be exceeded in the mixing zone at any point inhabitable by these organisms, unless it can be demonstrated to the MWRC that a higher concentration is acceptable."

Under the guidance offered by Rule 323.1082, the MWRC had adopted the policy,
8 in State-issued NPDES Permits, of limiting the intermittent discharge of total
residual chlorine from steam-electric plants to 0.5 mg/l through June 30, 1977
and to 0.20 mg/l and 0.04 mg/l (dependent upon water temperature) after
July 1, 1977. However, the MWRC has provided dischargers the opportunity to
demonstrate that chlorine concentrations higher than the July 1, 1977 limits
are acceptable. On January 13, 1977, Consumers Power Company submitted a
chlorine demonstration study(3) to the MWRC for all of its generating plants.
As a result of this demonstration study, the MWRC in 1978 established new
8 chlorine limits for Company facilities. The Company believes these new limits
are sufficient to allow effective condenser cleaning without the need to

dechlorinate or make other operational changes, however, the Company is
9 permitted to use certain dechlorination techniques to achieve the applicable limits.

8 The new limits restrict the discharge of total residual chlorine to receiving waters to 0.20 mg/l as a daily average computed on a monthly basis and to 0.30
9 mg/l as a maximum at existing steam-electric plants when chlorine application time does not exceed 160 minutes in any 24-hour period. Associated with these new limits has been an additional requirement that the Company conduct a
8 year-long study of the percentage of free chlorine discharged to the receiving waters at each of its existing steam-electric plants. Upon completion of this study, these limits will either be retained or modified by the MWRC.

It is expected that the chlorine concentration in the cooling pond blowdown
8 from the Midland Plant will be within these revised limits. If necessary, the pond blowdown will be suspended, as suggested in Recommendation 7(e), until the biocide (chlorine) degrades to acceptable discharge levels.

5.1.1.3.2 Phosphorus

The Federal Effluent Guidelines contain no applicable phosphorus limitations with regard to either the recommended limit of river concentration of phosphorus of 0.05 mg/l as found in 7(f) or the agreement(4) reached between Consumers Power Company and AEC Regulatory Staff Counsel Thomas F Engelhardt, whereby the 0.05 ppm in river concentration of phosphorus was rescinded in favor of a total discharge limitation of phosphates not to exceed an average of 35 pounds a day, exclusive of pond reconcentration of existing levels in the river. The Guidelines do, however, provide some guidance by establishing allowable phosphorus concentrations for cooling tower blowdown as published in

40 CFR, Section 423.13. These guidelines establish a daily maximum phosphorus concentration of 5.0 mg/l and a monthly average concentration of 5.0 mg/l.

MWRC Rule 323.1060 addresses plant nutrients. The Rule states in part: "Phosphorus which is or may readily become available as a plant nutrient shall be controlled from point source discharges by the application of methods utilizing best practicable waste treatment technology for control of total phosphorus, with the goal of achieving a monthly average effluent concentration of 1 milligram per liter as P."

5.1.2 <u>Physical Effects</u>

Cooling pond blowdown is discharged at the south bank of the Tittabawassee
River. The blowdown enters the river as a 30-inch (76-cm) diameter jet (or
jets) perpendicular to the river and rapidly mixes with river water through a
3 jet entrainment process. The Dow Chemical Company also discharges its
effluent at the south river bank. The Dow Chemical Company discharge is about
300 feet (91 m) upstream from the Plant blowdown discharge structure as shown
in Figure 5.1B-1. A thermal plume is formed by these two discharges along the
south bank of the Tittabawassee River. Field observation of The Dow Chemical
7 Company discharge and physical model testing results indicate that both The
Dow Chemical Company's tertiary pond discharge and the Plant blowdown achieve
full vertical mixing with river water. Thus the plume is only two dimensional
3 with equal temperature throughout the river depth.

A physical model is used to determine a set of maximum allowable blowdown
flowrates over ranges of blowdown excess temperatures (temperature of the
7 effluent less ambient natural river temperature) and river flows so that the
size of the resulting thermal plume is within State of Michigan Water Quality

Standards. Details of the physical model and test programs are described in
12 Appendix 5.1B-1 and in the final report of the physical model study[5] and in
the final cooling pond operation study[5a]. The independent variables used in
the physical model test program are: river discharge, Plant makeup flowrate,
9 plant blowdown (blowdown temperature less ambient river temperature) excess
temperature; total dissolved solids concentration, flowrate, and excess
temperature of The Dow Chemical Company effluent. Values of these variables
and the maximum allowable blowdown flowrates obtained from the model tests are
listed in Table 5.1-1. The isotherms for the worst case of each of the river
flows tested are shown in Figure 5.1-1 through Figure 5.1-5. In all cases,
thermal plumes defined by the 5°F (2.8°C) isotherm will not contain more than
25% of the river cross-sectional area or volume of river flow at any transect
on an average temperature basis which is in accordance with the State of
12 Michigan Water Quality Standards and the thermal plume lengths are limited to
1,700 feet (515 m).

During normal Plant operation, because of frequent changes in some of the
independent variables, especially the river flow, an automatic control system
is used to measure the independent variables, to calculate the blowdown
flowrate, and to set the valve openings for the calculated blowdown flow. The
9 cooling pond blowdown shall comply with Michigan Water Quality Standards
3 regarding temperatures, TDS, mixing zone length, and width. The cooling pond
is generally kept full when possible and therefore blowdown may be voluntarily
restricted when makeup cannot keep up with pond water losses caused by
9 evaporation and seepage. The operation of the cooling pond is simulated on a
daily basis over an 82-year period. The physical model test results together

9 with the following restrictions on the timing and the flowrate of blowdown were used in the simulation:

3 a. Set blowdown flowrate to zero if the measured natural river temperature exceeds the allowable monthly maximum temperatures.

9 b. After full mixing, at Freeland Bridge, the combined contribution of
3 TDS from both the Plant blowdown and The Dow Chemical Company effluent shall not cause the river TDS concentration to exceed 500 ppm.

c. When discharging, blowdown flowrate should be within the range from 5
9 cfs to 220 cfs.

The simulation results indicate that the blowdown discharge is most likely to
3 be continuous during March, April and May. For the remaining months, the blowdown discharge may be intermittent. During periods of blowdown, the
9 thermal plume will not be longer than 1700 feet (515 m) and will comply with the 25% river cross-sectional area or volume of flow limits of the Water Quality Standards on an average temperature basis.

5.1.3 Biological Effects

During the operation of the Midland Plant, the removal of heat will be accomplished by a closed-cycle system incorporating an 880-acre (356-ha) cooling pond containing 12,600 acre feet of water. The heat is dissipated from the cooling pond to the atmosphere by radiation, evaporation and convection.

Assessment of the impact of Plant operation on the aquatic system is based on the conceptual design of the circulating water system and condenser design

characteristics (refer to Section 3.4) and the biological analyses of the Tittabawassee River presented in Section 2.2. During Plant operation the impact on aquatic life occurs during the makeup or blowdown phases. Makeup water pumping is limited by the flowrate of the Tittabawassee River (refer to Section 3.4) and will approximate 5% of the river flow for average year conditions[6]. Aquatic studies conducted during 1977[7], 1978[7a] and
12 1979[7b] demonstrated that the Tittabawassee River in the vicinity of the Midland Plant is an improving ecosystem capable of supporting more diverse aquatic populations than reported in earlier studies[8,9]. The impacts of Plant operation on aquatic systems are related primarily to impingement and entrainment losses, and thermal and chemical effluent effects. Since most of the circulating water cooling is accomplished by the cooling pond and, because only a small portion of the river is used for makeup, these impacts are expected to be relatively small.

5.1.3.1 <u>Entrainment Effects</u>

Planktonic organisms such as phytoplankton, zooplankton, ichthyoplankton, macroinvertebrates and minnows may be drawn through 3/8-inch (0.95-cm) openings in the traveling screens and subsequently subjected to the mechanical, thermal and chemical effects associated with the condenser cooling system. It is assumed that many entrained organisms in the makeup water flow (average approximately 5% of river flow) will be eventually killed.

12 The distribution of planktonic organisms in the river is not uniform and concentrations are known to differ with location in the river and season of the year[7,7b]. Because of changing river characteristics and an incomplete preoperational biological data base, it is not currently possible to estimate

these losses. However, the number of organisms entrained and killed is expected to be negligible in comparison to the total river population.

Species identifications and determinations of concentrations of organisms
pumped into the pond with the initial filling were made by CMU in 1978[7a].
12 Many of the organisms will survive Plant operation, reproduce and may return
to the river as part of operational blowdown. However, during periods of full
operation, the thermal, chemical and mechanical stresses exerted in the
cooling pond and during condenser passage may limit the blowdown's
contribution to the river. The average monthly temperatures for the
Tittabawassee River, predicted monthly cooling pond surface temperatures, and
the differences are listed in Table 5.1-3.

5.1.3.2 Impingement Effects

The makeup intake structure is located adjacent to the south bank of the
12 Tittabawassee River and has a maximum withdrawal capacity of 270 cfs when all
three makeup pumps are in operation. The intake structure is designed to
provide a "sweep velocity" across the face of the intake screens which is
anticipated to minimize impingement by carrying fish past the intake[10].
Maximum average approach velocity of water toward the screens is designed not
12 to exceed 1 ft/s (30 cm/s) and most of the time will average approximately 0.5
ft/s (15 cm/s). The low approach velocities and higher river velocities
passing alongside the screens (1.5 - 2.0 ft/s) (45 - 60 cm/s) as well as the
intermittent withdrawal water for makeup will help insure that incidence of
fish impingement is minimal. As reported by CMU[7a], pond fill took place
12 during the spring (April-May) of 1978 and winter (November-December-January)

of 1978-1979. During spring 1978 approximately [illegible]0% of the pond was filled with the remaining volume pumped during the winter of 1978-1979. Spring impingement resulted in 1,256 fishes weighing 22.3 kilograms (49 pounds).
12 Young-of-the-year rock bass (Ambloplites rupestris) made up 66.3% of the numerical spring collection. During the winter 46,964 fishes weighing 314.6 kilograms (692 pounds) were impinged. Young-of-the-year yellow perch (Perca flavescens) comprised 94.6% of the number of fishes collected.

The intake structure and associated bank stabilization features serve as a shade, shelter, feeding and spawning habitat for several species in the river.
12 Some of these species may occasionally be impinged but the net result should be a gain in favorable fish habitat.

5.1.3.3 Thermal Effects

The thermal criteria for the cooling pond blowdown as stipulated by State of Michigan Water Quality Standards limits the mixing zone of the thermal plume to not more than 25% of the river flow or cross-sectional area and that the 5°F (2.8°C) isotherm of the plume will not exceed the mixing zone length as to be defined by MWRC. This thermal increment is greater than the variation of the natural stream temperature but normally within the tolerance limits of most fish currently inhabiting the river in the vicinity of the Plant (refer to Section 2.2). During operation, the species composition of fish and invertebrates in the thermal plume area may shift slightly towards the more heat tolerant species[8]. However, a measurable change is not expected due to
12 the intermittent nature of the discharge and the rapid mixing of the effluent (refer to Section 5.1.2) and relatively small mixing zone area.

When the thermal effluent is present, it may attract some individuals and be avoided by others. Carp, channel catfish, sunfish and bullheads are attracted to warmer temperatures[11] and may become more abundant in the plume area.
12 Migrating species (white sucker, northern pike, walleye, gizzard shad, yellow perch and chinook salmon) will have 75% of the cross-sectional area of the stream to avoid the effluent during both upstream and downstream movements. Due to the intermittent nature of the discharge, minimal attraction to the area is anticipated.

Fish that inhabit the thermal plume area and become acclimated to it may be subjected to stress when blowdown is terminated. Temperature drops occurring when blowdown ceases may be sudden but not necessarily stressful, depending
12 upon the ΔT between the effluent and the river. In any case, mobile organisms such as fish have the ability to remain in the thermal plume and become gradually acclimated to the cooler river water as the plume is mixed and dispersed downstream. Temperature changes of the blowdown during Plant
12 shutdowns should be gradual because the pond water volume moderates the temperature decrease.

12

It is conceivable that plankton production in the pool areas of the river mixing zone may increase slightly due to the elevated river temperatures. Also, the organic material and entrained plankton in the cooling pond will, during blowdown, become an available food source to benthic inhabitants and plankton-eating fishes in the river. Such conditions may bring about slight increases in benthic production which, however, would be of a low magnitude in relation to total river production in that vicinity (refer to Section 2.2).

Emergence times of certain aquatic insects inhabiting the plume area could
12 be advanced due to the slight elevation in water temperature. This early emergence would be limited to the thermal plume area and should not result in any adverse long-term effects to populations of the river in the vicinity of the Plant.

5.1.4 Effects of Heat Dissipation Facilities

5.1.4.1 Frequency of Fog Occurrence

Evaporation of water from the cooling pond will increase the ambient water vapor in the immediate vicinity of the pond. Under certain meteorological conditions, the evaporation may cause the air in contact with the pond to become saturated. Subsequent cooling will cause water vapor introduced into the air to condense and to become visible as fog, or more correctly, steam fog. The frequency of occurrence of this fog was estimated in two separate and independent analyses. In the first study[12] analytical models and studies from other cooling ponds in operation were used. The method of analysis was based on a "Fog Index Number" defined as follows:

$$\text{Fog Index Number} = \frac{\Delta T}{e_s - e_a} \qquad (5.1\text{-}1)$$

where

ΔT = the temperature of the water minus the temperature of the ambient air (°F),

e_s = saturation vapor pressure at ambient air temperature (millibars), and

e_a = actual vapor pressure of the ambient air (millibars)

The Fog Index Number is multiplied by the probability of occurrence of fog as a function of the Index Number to calculate the percent of time steam fog or stratus occurs. This study combined fog and stratus which is fog at least 50 feet (15m) above ground level. If natural fog exists, fog or stratus due to the Midland pond is expected 14.8% of the time in winter. When natural fog exists, pond fog only contributes to the density of the fog and not to the hours of occurrence. On an annual basis the predicted frequency of this type of fog is 8.4%. Without natural fog present, fog or stratus due to the cooling pond is predicted 43.5% of the time during winter months. On an annual basis, the comparable frequency is 25% and the maximum frequency of this pond-induced fog or stratus is associated with west-southwest winds.

The second analysis[13] yields frequencies of occurrence of different categories of fog that relate directly to reduced visibility and does not include stratus. Eight specific locations in the vicinity of the cooling pond were selected (Appendix 5.1C). The calculations used a 6-year record (1949-1954) of hourly meteorological observations made at Tri-City Airport. The procedure involved the determination, every 3 hours, of pond surface temperature, sensible heat loss, and evaporative heat loss to the atmosphere with a cooling pond performance model developed by Ryan and Harleman[14].

According to the surface isotherm pattern produced by the Ryan-Harleman model and the wind direction, the pond surface is divided into an appropriate array of 40 contiguous 300 by 300 meter (984 by 984 ft) squares, each of which was treated as a source of heat and moisture. The Gaussian diffusion equation is used to calculate heat and water vapor diffusion from each of the sources to each of the eight locations that are downwind from the pond for that hourly calculation. Plume buoyancy effects are partially accounted for by using

diffusion coefficients for the Brookhaven B_1 (unstable) diffusion category for plumes as long as they remain over the pond. The quantities obtained from all 40 source squares are summed for each location.

The occurrence of fog and the amount of condensed water are determined from
1 the standard saturation vapor pressure versus temperature relationship after the new temperature is calculated by taking into account the diffused sensible heat. Liquid water contents are converted to visibility by a relationship from Houghton and Radford[15]. Finally, the results are tabulated according to seven visibility categories (from less than 1/16 to 1 mile (0.1 to 1.6 km) or more), month, and time of day for each location.

A Summary of the findings is shown in Figure 5.1-6 which is a map of the cooling pond and its vicinity with the eight locations identified as A, B, C, D, E, F, G, and H. Each location has three numbers. The first is the annual average of the sum of the number of hours of fog due to the operation of the cooling pond and the number of hours during which its operation would add to natural fog and cause a further reduction in visibility. The second number is the computed average annual number of hours with fog specifically attributable to the pond. The third number is the computed average annual hours of fog at below freezing temperatures. Like the first number listed, it is the sum of both the number of hours of fog due to operation of the pond and the number of hours in which its operation would add to natural fog and cause a further reduction in visibility.

Except for the three locations on Gordonville Road (along the south edge of the cooling pond) fog caused by the pond alone would have occurred on an annual average of less than 50 hours per year. The three Gordonville Road

locations have annual averages of 73, 82, and 98 hours per year, respectively. The occurrences of cooling pond fog with natural fog are all less than an average of 200 hours per year except at two Gordonville Road locations which have values of 216 and 270 hours per year. Of the total number of fogs that occur, on an annual average, about 25% would occur with temperatures below freezing for the locations nearest the pond (C, E, F, and G). For the stations farther to the west (A, B, and D), the percentage varies from 16 to 18, while at Location H the percentage is only about 10.

Results of the more recent Portman-Weber[13] analysis that can be compared to the earlier Bechtel study[12] (ie, number of hours of fog due to the operation of the cooling pond) indicate that the Portman-Weber results are less conservative and more realistic. The Portman-Weber results are also in general agreement with observations made at the Dresden Nuclear Power Station by Murray and Trettel, Inc[16]. For nearly two full winters of observations at the cooling pond there, they found about 13 days each winter when "the steam fog was observed to have remained at or near the ground and to travel beyond the pond boundary for short periods of time . . . . The inland travel distance ranged from approximately 100 feet (30 m) to approximately 1.5 miles (2.4 km)." Those observations are valid only for the Dresden pond for the winters of 1972 and 1973. However, the general agreement of the Portman-Weber results with such observations support their validity.

5.1.4.2 Icing Buildup From Pond Fog

Rime is a milky granular deposit of ice that forms when supercooled water drops impinge upon exposed surfaces. The Bechtel report[12] predicts 0.4 inch (1.0 cm) of rime deposition in 10 hours on poles and wires. Similarly, the

report predicts an accumulation of 0.05 millimeter (0.002 in) in 10 hours on road surfaces.

Results obtained from observations made at the Dresden Nuclear Power Station by Murray and Trettel, Inc[16] show that inland penetration of rime icing is less than 100 feet (30 m) from the cooling pond.

In conclusion, these studies have shown that fog frequency, inland penetration, and icing potential of the steam fog originating from the cooling pond is relatively infrequent and limited to the general area of the pond. Fog and icing will not significantly affect the surrounding area with respect to potential damage to existing structures, residential occupancy, air traffic from nearby airports (including the Tri-City Airport), or traffic on nearby roads, except Gordonville Road which is immediately to the south of the pond. Signs will be posted on Gordonville Road warning motorists about possible icing on the road surface. Some icing damage may occur to the pond-screening vegetation which would require periodic replacement. If such damage should
12 occur, Consumers Power Company will replace those plantings whenever proper screening is no longer provided.

5.1.4.3 Noise From Service Water Cooling Towers

The projected noise levels due to the operation of the service water cooling towers are low in relation to the ambient noise levels in the area of the Plant, as described in Section 2.7, that no effects will result.

5.1.4.4 Effects on Ground Water

As indicated in Section 3.3, there is no planned use of ground water during operation of the Midland Plant.

The design of the cooling pond dikes provides impervious cutoff walls down to impervious natural material to prevent seepage of cooling water from the pond into the surface sands outside the dikes. The impervious soils between the surface sands and the deep artesian aquifer minimize downward seepage. Therefore, it is anticipated that the operation of the Plant will have
1 negligible effect on ground water.

5.1R REFERENCES

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ENVIRONMENTAL PROTECTION AGENCY EFFLUENT GUIDELINES AND STANDARDS FOR STEAM ELECTRIC POWER GENERATING

(40 CFR 423; 39 FR 36186, October 8, 1974, Effective November 7, 1974; 40 FR 7095, February 19, 1975; 40 FR 23987, June 4, 1975; 42 FR 15690, March 23, 1977; 43 FR 43025, September 22, 1978; 43 FR 44848, September 29 1978; 45 FR 37432, June 3, 1980; 45 FR 61619, September 17, 1980)

Title 40—Protection of the Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

[FRL 274-5]

SUBCHAPTER N—EFFLUENT GUIDELINES AND STANDARDS

PART 423—STEAM ELECTRIC POWER GENERATING POINT SOURCE CATEGORY

AUTHORITY: Secs. 301, 304 (b) and (c), 306 (b) and (c), 307(c) and 501(a) of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1215, 1311, 1314 (b) and (c), 1316 (b) and (c), 1317(c) and 1361(a)), 86 Stat. 816 et seq.; Pub. L. 92-500.

Subpart A—Generating Unit Subcategory

§ 423.10 Applicability; description of the generating unit subcategory.

The provisions of this subpart are applicable to discharges resulting from the operation of a generating unit by an establishment primarily engaged in the generation of electricity for distribution and sale which results primarily from a process utilizing fossil-type fuel (coal, oil, or gas) or nuclear fuel in conjunction with a thermal cycle employing the steam-water system as the thermodynamic medium.

§ 423.11 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

(b) The term "generating unit" shall mean any generating unit subject to the provisions of this part, except those units defined below as small, or old.

(c) The term "small unit" shall mean any generating unit subject to the provisions of this part, except a unit defined below as old, of less than 25 megawatts rated net generating capacity or any unit which is part of an electric utilities system with a total net generating capacity of less than 150 megawatts.

(d) The term "old unit" shall mean any generating unit, subject to the provisions of this part, of 500 megawatts or greater rated net generating capacity which was first placed in service on or before January 1, 1970 and any generating unit of less than 500 megawatts rated net generating capacity which was first placed in service on or before January 1, 1974.

(e) The term "blowdown" shall mean the minimum discharge of recirculating water for the purpose of discharging materials contained in the process, the further buildup of which would cause concentrations or amounts exceeding limits established by best engineering practice.

[40 FR 7095, February 19, 1975]

(f) The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in "Standard Methods for the Examination of Water and Wastewater", page 112 (13th edition).

(g) The term "sufficient land" shall mean 100 sq m (1100 sq ft) or more per megawatt of nameplate generating capacity.

(h) The term "low volume waste sources" shall mean, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established in this subpart. Low volume waste sources would include but are not limited to wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes and blowdown from recirculating house service water systems. Sanitary wastes and air conditioning wastes are specifically not included in low volume waste sources.

[40 FR 7095, February 19, 1975]

(i) The term "ash transport water" shall mean water used in the hydraulic transport of either fly ash or bottom ash.

(j) The term "metal cleaning wastes" shall mean any cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning and air preheater cleaning.

(k) The term "once through cooling water" shall mean water passed through the main cooling condensers in one or two passes for the purpose of removing waste heat from the generating unit.

(l) The term "recirculated cooling water" shall mean water which is passed through the main cooling condensers for the purpose of removing waste heat from the generating unit, passed through a cooling device for the purpose of removing such heat from the water and then passed again, except for blowdown, through the main cooling condensers.

[40 FR 7095, February 19, 1975]

(m) The term "cooling pond" shall mean any manmade water impoundment which does not impede the flow of a navigable stream and which is used to remove waste heat from heated condenser water prior to returning the recirculated cooling water to the main condenser.

(n) The term "cooling lake" shall mean any manmade water impoundment which impedes the flow of a navi-

gable stream and which is used to remove waste heat from heated condenser water prior to recirculating the water to the main condenser.

§ 423.12 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

(a) In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, utilization of facilities, raw materials, manufacturing processes, non-water quality, environmental impacts, control and treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations. In accordance with the decision in *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1358-60 (4th Cir. 1976), EPA's legal interpretation appearing at 39 FR 30073 (1974) shall not apply to this paragraph. The phrase "other such factors" appearing above may include significant cost differentials and the factors listed in section 301(c) of the Act. In no event may a discharger's impact on receiving water quality be considered as a factor under this paragraph.

[(a) amended by 43 FR 43025, September 22, 1978, 43 FR 44848, September 29, 1978; 45 FR 61619, September 17, 1980]

(b) The following limitations established the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

(1) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(2) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid. [40 FR 7095, February 19, 1975]

(3) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(4) The quantity of pollutants discharged in ash transport water shall not exceed the quantity determined by multiplying the flow of ash transport water times the concentration listed in the following table:

[40 FR 7095, February 19, 1975]

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(5) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(6) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(7) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(8) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(9) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or State, if the State has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(10) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (b) (1) through (9) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

[40 FR 7095, February 19, 1975]

§ 423.13 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

(a) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0

(b) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid. [40 FR 7095, February 19, 1975]

(c) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l.	30 mg/l.
Oil and Grease	20 mg/l.	15 mg/l.

(d) The quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed in the following table and dividing the product by 12.5:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l.	30 mg/l.
Oil and Grease	20 mg/l.	15 ml/l.

(e) The quantity of pollutants discharged in fly ash transport water shall not exceed the quality determined by multiplying the flow of fly ash transport water times the concentration listed in the following table:
[40 FR 7095, February 19, 1975]

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l.	30 mg/l.
Oil and Grease	20 mg/l.	15 mg/l.

(f) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l.	30 mg/l.
Oil and Grease	20 mg/l.	15 mg/l.
Copper, Total	1.0 mg/l.	1.0 mg/l.
Iron, Total	1.0 mg/l.	1.0 mg/l.

(g) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l.	30 mg/l.
Oil and Grease	20 mg/l.	15 mg/l.
Copper, Total	1.0 mg/l.	1.0 mg/l.
Iron, Total	1.0 mg/l.	1.0 mg/l.

(h) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water sources times the concentration listed in the following table:
[40 FR 7095, February 19, 1975]

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l.	0.2 mg/l.

(i) The quantity of pollutants discharged from cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l.	0.2 mg/l.
	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
Zinc	1.0 mg/l.	1.0 mg/l.
Chromium	0.2 mg/l.	0.2 mg/l.
Phosphorus	5.0 mg/l.	5.0 mg/l.
Other corrosion inhibiting materials.	Limit to be established on a case by case basis.	

(j) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(k) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (j) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

(l) There shall be no discharge of heat from the main condensers except:

(1) Heat may be discharged in blowdown from recirculated cooling water systems provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculating cooling water prior to the addition of the make-up water.

(2) Heat may be discharged in blowdown from recirculated cooling water systems which have been designed to discharge blowdown water at a temperature above the lowest temperature of recirculated cooling water prior to the addition of make-up water providing such recirculating cooling systems have been placed in operation or are under construction prior to the effective date of this regulation.

(3) Heat may be discharged in blowdown (overflow) from a cooling pond or cooling lake where the owner or operator of a unit otherwise subject to this limitation can demonstrate that a cooling pond, or cooling lake in service or under construction as of the effective date of this regulation, is used to cool recirculated cooling water before it is recirculated to the main condensers.

[40 FR 7095, February 19, 1975]

(4) Heat may be discharged where the owner or operator of a unit otherwise subject to this limitation can demonstrate that sufficient land for the construction and operation of mechanical draft evaporative cooling towers is not available (after consideration of alternate land use assignments) on the premises or on adjoining property under the ownership or control of the owner or operator as of March 4, 1974, and that no alternate recirculating cooling system is practicable.

(5) Heat may be discharged where the owner or operator of a unit otherwise subject to this limitation can demonstrate that the total dissolved solids concentration in blowdown exceeds 30,000 mg/1 and land not owned or controlled by the owner or operator as of March 4, 1974, is located within 150 meters (500 feet) in the prevailing downwind direction of every practicable location for mechanical draft cooling towers and that no alternate recirculating cooling system is practicable.

(6) Heat may be discharged where the owner or operator of a unit otherwise subject to this limitation can demonstrate to the regional administrator or State, if the State has NPDES permit issuing authority, that the plume which must necessarily emit from a cooling tower would cause a substantial hazard to commercial aviation and that no alternate recirculated cooling water system is practicable. In making such demon-

stration to the regional administrator or State the owner or operator of such unit must include a finding by the Federal Aviation Administration that the visible plume emitted from a well-operated cooling tower would in fact cause a substantial hazard to commerical aviation in the vicinity of a major commercial airport.

(m) The limitation of paragraph "l" of this section shall become effective on July 1, 1981.

(n) In the event that a regional reliability council, or when no functioning regional reliability council exists, a major utility or consortium of utilities, can demonstrate to the regional administrator or State, if the State has NPDES permit issuing authority, that the system reliability would be seriously impacted by complying with the effective date set forth in paragraph (m) above, the regional administrator may accept an alternative proposed schedule of compliance on the part of all the utilities concerned providing, however, that such schedule of compliance will require that units representing not less than 50 percent of the affected generating capacity shall meet the compliance date, that units representing not less than an additional 30 percent of the generating capacity shall comply not later than July 1, 1982 and the balance of units shall comply not later than July 1, 1983.

§ 423.14 Pretreatment standards for existing sources.

[42 FR 15690, March 23, 1977]

For the purpose of establishing pretreatment standards under section 307 (b) of the Act for a source within the general unit subcategory, small unit subcategory or old unit subcategory, the provisions of 40 CFR 128 shall not apply. The pretreatment standards for an existing source within the general unit subcategory (§ 423.14), small unit subcategory (§ 423.24) and old unit subcategory (§ 423.34) are set forth below.

(a) No pollutant (or pollutant property) introduced into a publicly owned treatment works shall interfere with the operation or performance of the works. Specifically, the following wastes shall not be introduced into the publicly owned treatment works:

(1) Pollutants which create a fire or explosion hazard in the publicly owned treatment works.

(2) Pollutants which will cause corrosive structural damage to treatment works, but in no case pollutants with a pH lower than 5.0, unless the works is designed to accommodate such pollutants.

(3) Solid or viscous pollutants in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

(4) Pollutants at either a hydraulic flow rate or pollutant flow rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

(b) In addition to the general prohibitions set forth in paragraph (a) of this section, the following pretreatment standard establishes the quality or quantity of pollutants or pollutant properties controlled by this section which may be introduced into a publicly owned treatment works by a source subject to the provisions of this subpart.

(1) There shall be no discharge to publicly owned treatment works of polychlorinated biphenyl compounds such as those used for transformer fluid.

(2) The quantity of copper discharged in metal cleaning wastes to publicly owned treatment works shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times 1 mg/l.

(3) The quantity of oil and grease in the plant's combined discharge to the publicly owned treatment works shall not exceed the quantity determined by multiplying the flow of the combined discharge times 100 mg/l.

(c) Any owner or operator of any source to which the pretreatment standards required by § 423.14(a), § 423.24(a) and § 423.34(a) are applicable, shall be in compliance with such standards upon the effective date of such standards. The time for compliance with standards required by § 423.14(b), § 423.24(b) and § 423.34(b) shall be within the shortest time but not later than three years from the effective date of such standards.

§ 423.15 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

(a) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(b) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

[40 FR 7095, February 19, 1975]

(c) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(d) The quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed in the following table and dividing the product by 20:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(e) There shall be no discharge of TSS or oil and grease in fly ash transport water.

(f) The quantity of pollutants discharged from metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(g) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(h) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l.........	0.2 mg/l.

(i) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l.........	0.2 mg/l.
	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
Materials added for corrosion inhibition including but not limited to zinc, chromium, Phosphorus.	No detectable amount.	No detectable amount.

(j) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(k) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (j) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

(l) There shall be no discharge of heat from the main condensers except:

(1) Heat may be discharged in blowdown from recirculated cooling water systems provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water.

(2) Heat may be discharged in blowdown from cooling ponds provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water.

§ 423.16 Pretreatment standards for new sources.

The pretreatment standards under section 307(c) of the Act for a source within the generating unit subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 306 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.133 shall be amended to read as follows:

In addition to the prohibitions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works shall be the standard of performance for new sources specified in 40 CFR 423.15 except for the following pollutants or pollutant parameters for which the following pretreatment standards are established:

Pollutant or pollutant parameter:	*Pretreatment standard*
Heat	No limitation.
Free available chlorine....	No limitation.
Total residual chlorine....	No limitation.

If the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant.

[40 FR 7095, February 19, 1975]

Subpart B—Small Unit Subcategory

§ 423.20 Applicability; description of the small unit subcategory.

The provisions of this subpart are applicable to discharges resulting from the operation of a small unit by an establishment primarily engaged in the generation of electricity for distribution and sale which results primarily from a process utilizing fossil-type fuel (coal, oil, or gas) or nuclear fuel in conjunction with a thermal cycle employing the steam-water system as the thermodynamic medium.

§ 423.21 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

(b) The term "small unit" shall mean any generating unit subject to the provisions of this part, except a unit defined below as old, of less than 25 megawatts rated net generating capacity or any unit which is part of an electric utilities system with a total net generating capacity of less than 150 megawatts.

(c) The term "old unit" shall mean any generating unit, subject to the provisions of this part, of 500 megawatts or greater rated net generating capacity which was first placed in service on or before January 1, 1970 and any generating unit of less than 500 megawatts rated net generating capacity which was first placed in service on or before January 1, 1974.

(d) The term "blowdown" shall mean the minimum discharge of recirculating water for the purpose of discharging materials contained in the process, the further buildup of which would cause concentrations or amounts exceeding limits established by best engineering practice.

[40 FR 7095, February 19, 1975]

(e) The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in "Standard Methods for the Examination of Water and Wastewater", page 112 (13th Edition).

(f) The term "low volume waste sources" shall mean, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established in this subpart. Low volume waste sources would include but are not limited to wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes and blowdown from recirculating house service water systems. Sanitary wastes and air conditioning wastes are specifically not included in low volume waste sources.

[40 FR 7095, February 19, 1975]

(g) The term "ash transport water" shall mean water used in the hydraulic transport of either fly ash or bottom ash.

(h) The term "metal cleaning wastes" shall mean any cleaning compounds rinse waters, or any other waterborne residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning and air preheater cleaning.

(i) The term "once through cooling water" shall mean water passed through the main cooling condensers in one or two passes for the purpose of removing waste heat from the generating unit.

(j) The term "recirculated cooling water" shall mean water which is passed through the main cooling condensers for the purpose of removing waste heat from

the generating unit, passed through a cooling device for the purpose of removing such heat from the water and then passed again, except for blowdown, through the main cooling condensers.

[40 FR 7095, February 19, 1975]

(k) The term "cooling pond" shall mean any manmade water impoundment which does not impede the flow of a navigable stream and which is used to remove waste heat from heated condenser water prior to returning the recirculated cooling water to the main condenser.

§ 423.22 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

(a) In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, utilization of facilities, raw materials, manufacturing processes, non-water quality environmental impacts, control and treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations. In accordance with the decision in *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1358-60 (4th Cir. 1976), EPA's legal interpretation appearing at 39 FR 30073 (1974) shall not apply to this paragraph. The phrase "other such factors" appearing above may include significant cost differentials and the factors listed in section 301(c) of the Act. In accordance with the decision in *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1358-60 (4th Cir. 1976), EPA's legal interpretation appearing at 39 FR 30073 (1974) shall not apply to this paragraph. The phrase "other such factors" appearing above may include significant cost differentials and the factors listed in section 301(c) of the Act. In no event may a discharger's impact on receiving water quality be considered as a factor under this paragraph.

[(a) amended by 43 FR 43025, September 22, 1978, 43 FR 44848, September 29, 1978; 45 FR 61619, September 17, 1980]

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

(1) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(2) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

[40 FR 7095, February 19, 1975]

(3) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(4) The quantity of pollutants discharged in ash transport water shall not exceed the quantity determined by multiplying the flow of ash transport water times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(5) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(6) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(7) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(8) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(9) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(10) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of

each pollutant or pollutant property controlled in paragraphs (b) (1) through (9) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

[40 FR 7095, February 19, 1975]

§ 423.23 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable:

(a) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(b) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

(c) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(d) The quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed in the following table and dividing the product by 12.5:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(e) The quantity of pollutants discharged in fly ash transport water shall not exceed the quantity determined by multiplying the flow of fly ash transport water times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(f) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(g) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(h) The quantity of pollutants discharged in once through condenser water shall not exceed the quantity determined by multiplying the flow of once through condenser water sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(i) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

Effluent Characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
Zinc	1.0 mg/l	1.0 mg/l.
Chromium	0.2 mg/l	0.2 mg/l.
Phosphorus	5.0 mg/l	5.0 mg/l.
Other corrosion inhibiting materials.	Limit to be established on a case by case basis.	

[40 FR 7095, February 19, 1975]

(j) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(k) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (j) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

§ 423.24 Pretreatment standards for existing sources.

[42 FR 15690, March 23, 1977]

For the purpose of establishing pretreatment standards under Section 307 (b) of the Act for a source within the general unit subcategory, small unit subcategory or old unit subcategory, the provisions of 40 CFR 128 shall not apply. The pretreatment standards for an existing source within the general unit subcategory (§ 423.14), small unit subcategory (§ 423.24) and old unit subcategory (§ 423.34) are set forth below.

(a) No pollutant (or pollutant property) introduced into a publicly owned treatment works shall interfere with the operation or performance of the works. Specifically, the following wastes shall not be introduced into the publicly owned treatment works:

(1) Pollutants which create a fire or explosion hazard in the publicly owned treatment works.

(2) Pollutants which will cause corrosive structural damage to treatment works, but in no case pollutants with a pH lower than 5.0, unless the works is designed to accommodate such pollutants.

(3) Solid or viscous pollutants in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

(4) Pollutants at either a hydraulic flow rate or pollutant flow rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

(b) In addition to the general prohibitions set forth in paragraph (a) of this section, the following pretreatment standard establishes the quality or quantity of pollutants or pollutant properties controlled by this section which may be introduced into a publicly owned treatment works by a source subject to the provisions of this subpart.

(1) There shall be no discharge to publicly owned treatment works of polychlorinated biphenyl compounds such as those used for transformer fluid.

(2) The quantity of copper discharged in metal cleaning wastes to publicly owned treatment works shall not exceed

the quantity determined by multiplying the flow of metal cleaning wastes times 1 mg/l.

(3) The quantity of oil and grease in the plant's combined discharge to the publicly owned treatment works shall not exceed the quantity determined by multiplying the flow of the combined discharge time 100 mg/l.

(c) Any owner or operator of any source to which the pretreatment standards required by § 423.14(a), § 423.24(a) and § 423.34(a) are applicable, shall be in compliance with such standards upon the effective date of such standards. The time for compliance with standards required by § 423.14(b), § 423.24(b) and § 423.34(b) shall be within the shortest time but not later than three years from the effective date of such standards.

§ 423.25 Standards of performance for new sources.

The following standards of performance establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a new source subject to the provisions of this subpart:

(a) The pH [illegible] ccept once through c[illegible] ll, be within the range [illegible]

(b) There sha[illegible]charge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

[40 FR 7095, February 19, 1975]

(c) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l

(d) The quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed in the following table and dividing the product by 20:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(e) There shall be no discharge of TSS or oil and grease in fly ash transport water.

(f) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(g) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(h) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(i) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
Materials added for corrosion inhibition including zinc, chromium, phosphorus and other.	No detectable amount.	No detectable amount.

(j) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(k) In the event that waste steams from various sources are combined for treatment, or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (j) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

(l) There shall be no discharge of heat from the main condensers except:

(1) Heat may be discharged in blowdown from recirculated cooling water systems provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water.

(2) Heat may be discharged in blowdown from cooling ponds provided the temperature at which the blowdown is discharged does not exceed at any time the lowest temperature of recirculated cooling water prior to the addition of the make-up water.

§ 423.26 Pretreatment standards for new sources.

The pretreatment standards under section 307(c) of the Act for a source within the small unit subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 307 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.133 shall be amended to read as follows:

In addition to the prohibitions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works shall be the standard of performance for new sources specified in 40 CFR 423.25 except for the following pollutants or pollutant parameters for which the following pretreatment standards are established:

Pollutant or pollutant parameter	*Pretreatment standard*
Heat	No limitation.
Free available chlorine.	No limitation.
Total residual chlorine.	No limitation.

If the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant,

the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant.

[40 FR 7095, February 19, 1975]

Subpart C—Old Unit Subcategory

§ 423.30 Applicability; description of the old unit subcategory.

The provisions of this subpart are applicable to discharges resulting from the operation of an old unit by an establishment primarily engaged in the generation of electricity for distribution and sale which results primarily from a process utilizing fossil-type fuel (coal, oil, gas) or nuclear fuel in conjunction with a thermal cycle employing the steam-water system as the thermodynamic medium.

[40 FR 7095, February 19, 1975]

§ 423.31 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

(b) The term "old unit" shall mean any generating unit, subject to the provisions of this part, of 500 megawatts or greater rated net generating capacity which was first placed in service on or before January 1, 1970 and any generating unit of less than 500 megawatts rated net generating capacity which was first placed in service on or before January 1, 1974.

(c) The term "blowdown" shall mean the minimum discharge of recirculating water for the purpose of discharging materials contained in the process, the further buildup of which would cause concentrations or amounts exceeding limits established by best engineering practice.

[40 FR 7095, February 19, 1975]

(d) The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in "Standard Methods for the Examination of Water and Wastewater", page 112 (13th Edition).

(e) The term "low volume waste sources" shall mean, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established in this subpart. Low volume waste sources would include but are not limited to wastewaters from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, floor drainage, cooling tower basin cleaning wastes and blowdown from recirculating house service water systems. Sanitary wastes and air conditioning wastes are specifically not included in low volume waste sources.

[40 FR 7095, February 19, 1975]

(f) The term "ash transport water" shall mean water used in the hydraulic transport of either fly ash or bottom ash.

(g) The term "metal cleaning wastes" shall mean any cleaning compounds, rinse waters, or any other waterborne residues derived from cleaning any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning and air preheater cleaning.

(h) The term "once through cooling water" shall mean water passed through the main cooling condensers in one or two passes for the purpose of removing waste heat from the generating unit.

[40 FR 7095, February 19, 1975]

(i) The term "recirculated cooling water" shall mean water which is passed through the main cooling condensers for the purpose of removing waste heat from the generating unit, passed through a cooling device for the purpose of removing such heat from the water and then passed again, except for blowdown, through the main cooling condensers.

[40 FR 7095, February 19, 1975]

§ 423.32 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

(a) In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, utilization of facilities, raw materials, manufacturing processes, non-water quality environmental impacts, control and treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations. In accordance with the decision in *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1358-60 (4th Cir. 1976), EPA's legal interpretation appearing at 39 FR 30073 (1974) shall not apply to this paragraph. The phrase "other such factors" appearing above may include significant cost differentials and the factors listed in section 301(c) of the Act. In no event may a discharger's impact on receiving water quality be considered as a factor under this paragraph.

[(a) amended by 43 FR 43025, September 22, 1978, 43 FR 44848, September 29, 1978; 45 FR 61619, September 17, 1980]

(b) The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

(1) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(2) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

[40 FR 7095, February 19, 1975]

(3) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l
Oil and Grease	20 mg/l	15 mg/l

(4) The quantity of pollutants discharged in ash transport water shall not exceed the quantity determined by multiplying the flow of ash transport water times the concentration listed in the following table.

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(5) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(6) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

(7) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(8) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

(9) Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(10) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (b) (1) through (9) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

[40 FR 7095, February 19, 1975]

§ 423.33 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

The following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best available technology economically achievable.
[40 FR 7095, February 19, 1975]

(a) The pH of all discharges, except once through cooling water, shall be within the range of 6.0–9.0.

(b) There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

[40 FR 7095, February 19, 1977]

(c) The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed—
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(d) The quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed in the following table and dividing the product by 12.5:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed—
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(e) The quantity of pollutants discharged in fly ash transport water shall not exceed the quantity determined by multiplying the flow of fly ash transport water times the concentration listed in the following table:

Effluent characteristic	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.

(f) The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

Effluent characteristic	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(g) The quantity of pollutants discharged in boiler blowdown shall not exceed the quantity determined by multiplying the flow of boiler blowdown times the concentration listed in the following table:

Effluent characteristic	Maximum for any one day	Average of daily values for thirty consecutive days shall not exceed
TSS	100 mg/l	30 mg/l.
Oil and Grease	20 mg/l	15 mg/l.
Copper, Total	1.0 mg/l	1.0 mg/l.
Iron, Total	1.0 mg/l	1.0 mg/l.

(h) The quantity of pollutants discharged in once through cooling water shall not exceed the quantity determined by multiplying the flow of once through cooling water sources times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.

[40 FR 7095, February 19, 1975]

(i) The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown times the concentration listed in the following table:

Effluent Characteristic	Maximum Concentration	Average Concentration
Free available chlorine.	0.5 mg/l	0.2 mg/l.
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed—
Zinc	1.0 mg/l	1.0 mg/l.
Chromium	0.2 mg/l	0.2 mg/l.
Phosphorus	5.0 mg/l	5.0 mg/l.
Other corrosion inhibiting materials.	Limit to be established on a case by case basis.	

[40 FR 7095, February 19, 1975]

(j) Neither free available chlorine nor total residual chlorine may be discharged from any [illegible] more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the regional administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

(k) In the event that waste streams from various sources are combined for treatment or discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (j) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

§ 423.34 Pretreatment standards for existing sources.

[42 FR 15690, March 23, 1977]

For the purpose of establishing pretreatment standards under Section 307 (b) of the Act for a source within the general unit subcategory, small unit subcategory or old unit subcategory, the provisions of 40 CFR 128 shall not apply. The pretreatment standards for an existing source within the general unit subcategory (§ 423.14), small unit subcategory (§ 423.24) and old unit subcategory (§ 423.34) are set forth below.

(a) No pollutant (or pollutant property) introduced into a publicly owned treatment works shall interfere with the operation or performance of the works. Specifically, the following wastes shall not be introduced into the publicly owned treatment works:

(1) Pollutants which create a fire or explosion hazard in the publicly owned treatment works.

(2) Pollutants which will cause corrosive structural damage to treatment works, but in no case pollutants with a pH lower than 5.0, unless the works is designed to accommodate such pollutants.

(3) Solid or viscous pollutants in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

(4) Pollutants at either a hydraulic flow rate or pollutant flow rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

(b) In addition to the general prohibitions set forth in paragraph (a) of this section, the following pretreatment standard establishes the quality or quantity of pollutants or pollutant properties controlled by this section which may be introduced into a publicly owned treatment works by a source subject to the provisions of this subpart.

(1) There shall be no discharge to publicly owned treatment works of polychlorinated biphenyl compounds such as those used for transformer fluid.

(2) The quantity of copper discharged in metal cleaning wastes to publicly owned treatment works shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times 1 mg/l.

(3) The quantity of oil and grease in the plant's combined discharge to the publicly owned treatment works shall not exceed the quantity determined by multiplying the flow of the combined discharge times 100 mg/l.

(c) Any owner or operator of any source to which the pretreatment standards required by § 423.14(a), § 423.24(a) and § 423.34(a) are applicable, shall be in compliance with such standards upon the effective date of such standards. The time for compliance with standards required by § 423.14(b), § 423.24(b) and § 423.34(b) shall be within the shortest time but not later than three years from the effective date of such standards.

Subpart D—Area Runoff Subcategory

The provisions of this subpart are applicable to discharges resulting from runoff from coal piles at units subject to the limitations in Subparts A, B, or C of this part.

[423.40 revised by 45 FR 37432, June 3, 1980]

§ 423.41 Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations and methods of analysis set forth in 40 CFR Part 401 shall apply to this subpart.

(b) The term "10 year, 24 hour rainfall event" shall mean a rainfall event with a probable recurrence interval of once in ten years as defined by the National Weather Service in Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," May 1961, and subsequent amendments, or equivalent regional or State rainfall probability information developed therefrom.

423.41 (d) redesignated as (b) by 45 FR 37432, June 3, 1980]

§ 423.42 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best practicable control technology currently available.

In establishing the limitations set forth in this section, EPA took into account all information it was able to collect, develop and solicit with respect to factors (such as age and size of plant, utilization of facilities, raw materials, manufacturing processes, non-water quality environmental impacts, control and treatment technology available, energy requirements and costs) which can affect the industry subcategorization and effluent levels established. It is, however, possible that data which would affect these limitations have not been available and, as a result, these limitations should be adjusted for certain plants in this industry. An individual discharger or other interested person may submit evidence to the Regional Administrator (or to the State, if the State has the authority to issue NPDES permits) that factors relating to the equipment or facilities involved, the process applied, or other such factors related to such discharger are fundamentally different from the factors considered in the establishment of the guidelines. On the basis of such evidence or other available information, the Regional Administrator (or the State) will make a written finding that such factors are or are not fundamentally different for that facility compared to those specified in the Development Document. If such fundamentally different factors are found to exist, the Regional Administrator or the State shall establish for the discharger effluent limitations in the NPDES permit

either more or less stringent than the limitations established herein, to the extent dictated by such fundamentally different factors. Such limitations must be approved by the Administrator of the Environmental Protection Agency. The Administrator may approve or disapprove such limitations, specify other limitations, or initiate proceedings to revise these regulations. In accordance with the decision in *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1358-60 (4th Cir. 1976), EPA's legal interpretation appearing at 39 FR 30073 (1974) shall not apply to this paragraph. The phrase "other such factors" appearing above may include significant cost differentials and the factors listed in section 301(c) of the Act. In no event may a discharger's impact on receiving water quality be considered as a factor under this paragraph.

[423.42. amended by 43 FR 43025, September 22, 1978, 43 FR 44848, September 29, 1978; 45 FR 61619, September 17, 1980]

(a) Subject to the provisions of paragraph (b) of this section, the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic:	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
ph	Within the range 6.0 to 9.0.

(b) Any untreated overflow from facilities designed, constructed and operated to treat the volume of material storage runoff and construction runoff which is associated with a 10 year, 24 hour rainfall event shall not be subject to the limitations in subparagraph (a) of this section.

§ 423.43 Effluent limitations guidelines representing the degree of effluent reduction attainable by the application of the best available technology economically achievable.

(a) Subject to the provisions of paragraph (b) of this section, the following limitations establish the quantity or quality of pollutants or pollutant properties, controlled by this section, which may be discharged by a point source subject to the provisions of this subpart after application of the best practicable control technology currently available:

Effluent characteristic:	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
ph	Within the range 6.0 to 9.0.

(b) Any untreated overflow from facilities designed, constructed and operated to treat the volume of material storage runoff and construction runoff which results from a 10 year, 24 hour rainfall event shall not be subject to the limitations in paragraph (a) of this section.

§ 423.44 Pretreatment standards for existing sources.

[42 FR 15690, March 23, 1977]

For the purpose of establishing pretreatment standards under section 307 (b) of the Act for a source within the area runoff subcategory, the provisions of 40 CFR 128 shall not apply. The pretreatment standards for an existing source within the area runoff subcategory are set forth below.

(a) No pollutant (or pollutant property) introduced into a publicly owned treatment works shall interfere with the operation or performance of the works. Specifically, the following wastes shall not be introduced into the publicly owned treatment works:

(1) Pollutants which create a fire or explosion hazard in the publicly owned treatment works.

(2) Pollutants which will cause corrosive structural damage to treatment works, but in no case pollutants with a pH lower than 5.0, unless the works is designed to accommodate such pollutants.

(3) Solid or viscous pollutants in amounts which would cause obstruction to the flow in sewers, or other interference with the proper operation of the publicly owned treatment works.

(4) Pollutants at either a hydraulic flow rate or pollutant flow rate which is excessive over relatively short time periods so that there is a treatment process upset and subsequent loss of treatment efficiency.

(b) Any owner or operator of any source to which the pretreatment standards required by § 423.44(a) are applicable, shall be in compliance with such standards upon the effective date of such standards.

§ 423.45 Standards of performance for new sources.

(a) Subject to the provisions of paragraph (b) of this section, the following standards of performance establish the quantity or quality of pollutants or pollutant properties, which may be discharged by a new source subject to the provisions of this subpart:

Effluent characteristic:	*Effluent limitations*
TSS	Not to exceed 50 mg/l.
ph	Within the range 6.0 to 9.0.

(b) Any untreated overflow from facilities designed, constructed and operated to treat the volume of material storage runoff and construction runoff which results from a 10 year, 24 hour rainfall event shall not be subject to the ph and TSS limitations stipulated in paragraph (a) of this section.

§ 423.46 Pretreatment standards for new sources.

The pretreatment standards under section 307(c) of the Act for a source within the area runoff subcategory, which is a user of a publicly owned treatment works (and which would be a new source subject to section 306 of the Act, if it were to discharge pollutants to the navigable waters), shall be the standard set forth in 40 CFR Part 128, except that, for the purpose of this section, 40 CFR 128.133 shall be amended to read as follows:

In addition to the prohibtions set forth in 40 CFR 128.131, the pretreatment standard for incompatible pollutants introduced into a publicly owned treatment works shall be the standard of performance for new sources specified in 40 CFR 423.45; *Provided*, That, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment works shall, except in the case of standards providing for no discharge of pollutants, be correspondingly reduced in stringency for that pollutant.

5.6 OTHER EFFECTS

12 5.6.1 Impact of Attracting Waterfowl and Other Waterbirds to Cooling Pond

4 The Midland Plant cooling pond, together with The Dow Chemical Company's
tertiary treatment pond, are significant attractants to waterfowl, gulls and
12 shorebirds. Table 2.2-1a contains a listing of waterbirds recorded during the
Applicant's preoperational monitoring program[1,2]. The two ponds are
discussed since the presence, characteristics and history of The Dow Chemical
4 Company tertiary pond clearly affect the present and potential impact of the
Midland Plant cooling pond on area waterfowl.

The Applicant's preoperational monitoring program has shown that both ponds
attract large numbers of waterfowl during Spring and Fall migrations. Both
ponds are also used by a smaller but significant number of resident waterfowl
12 during the Summer. The Midland Plant cooling pond also supports a large,
breeding population of ring-billed gulls, which persists on the pond from ice-
out, usually in late March, until the pond freezes (in December in 1979 and
1980).

The Dow Chemical Company's tertiary treatment pond, which is shallow and
4 dotted with emergent vegetation, is attractive to dabbling ducks and geese.
The Midland Plant cooling pond is deeper and used principally by diving ducks,
12 although dabbling ducks and geese use its shallow areas and/or areas of
submerged vegetation for feeding and the open dikes for resting. The Dow
4 Chemical Company's pond has a history of usage by waterfowl for both feeding
and nesting; at times the pond harbors hundreds of ducks and geese. This pond
12 and its outfall, which are seldom completely frozen in winter, also harbor
wintering populations of waterfowl[3].

The Midland Plant cooling pond is a new pond which was filled to 60% capacity
in the spring of 1978 and to full capacity in January 1979. It thus has no
12 long-established history of usage. Nevertheless, utilization of the pond by
waterbirds has been substantial, with numbers and species diversity increasing
as the pond ecosystem diversifies and perhaps as pond usage becomes a part of
waterbird behavioral patterns. It is anticipated that the presence of the two
4 ponds of disparate characteristics in close proximity to one another may have
additive or synergistic impacts on area avifauna.

4 Perhaps the greatest potential for cooling pond impact derives from the pond's
warm winter temperatures, which should result in an ice-free surface.
Providing that adequate food is naturally available, either on or off site,
12 ducks, geese, gulls and other waterbirds may overwinter on the cooling pond,
which may have positive and negative implications[4]. On the positive side,
4 waterfowl would be provided with a year-round sanctuary which would provide
12 limited nesting opportunities and extensive resting areas, together with
protection from hunting, predators, and severe weather on Saginaw Bay. The
presence of the waterfowl themselves would improve the natural and aesthetic
amenities of this generally industrial area. On the negative side, several
adverse impacts could occur:

4 a. Birds might be exposed to heavier hunting pressure locally than if they had migrated.

b. Area farms might suffer from crop depredations due to continual use by large numbers of waterfowl.

c. Large numbers of waterfowl in the area might promote hunter density related problems on local farms, eg, trespass, general harassment.

d. "Short-stopping" of waterfowl by the pond complex could result in decreased recreational opportunities in traditional hunting areas.

e. Concentrations of waterfowl could lead to disease problems.

f. Concentrations of waterfowl on the ponds might result in fatal collisions with power lines and Plant structures, particularly under
4 foggy conditions. This tendency should be offset, however, by the routing of Plant transmission lines. These lines will cross only a small portion of the cooling pond near the Plant, and parallel existing lines at the Tittabawassee River crossing. This practice of "bunching" lines for enhanced visibility, together with the use of nonguyed towers, is recommended by the US Fish and Wildlife Service to reduce collisions[5]. Under preoperational conditions, loss of
12 waterbirds to collisions with Midland Plant structures and transmission lines has been negligible[1,2].

g. Fecal material from numerous waterbirds may enrich the pond, thus
4 promoting the growth of aquatic organisms which may hamper the pond's
12 cooling efficiency (refer to Section 5.6.2). Cooling pond water quality may be impaired by fecal inputs.

4 All of these effects are predicated on heavy usage of the cooling pond by
12 waterbirds. The preoperational and operational studies outlined in Sec-
4 tions 6.1.4.3 and 6.2A-3.1.2.2 will allow the quantitative analyses of cooling
12 pond usage levels and direct effects of waterbird-related impacts. If, during the course of these studies, problems of consequence such as those
4 hypothesized above become evident, additional studies may be necessary.

5.6.2 Impact of Plant Operation on Biological System in Cooling Pond

During the initial filling of the pond in April 1978, small fish plankton,
periphyton and benthic organisms contained in the makeup intake water
colonized the cooling pond. Preliminary entrainment and impingement data are
12 in Lenon, et al, 1979[6]. The aquatic organisms that entered the pond were
able to perpetuate themselves. Their population structures are expected to
become modified compared to the rivers in response to different flow,
temperature, depth and environmental conditions in the pond. Monitoring of
entrainment during the initial phase of pond filling showed that 15 fish
species were identified among the larvae and juveniles, with cyprinids larvae
3 unidentified to species. Cyprinids, which include carp and minnows, comprised
approximately 84% of the 1,614 larvae and juveniles taken. Macroinvertebrate
entrainment was dominated by midges which ranged from 17% to 93.6% of the
total organisms/sample.

During operation, the average summer (July, August) water temperature in the
pond is anticipated to be 38°C (100°F). This temperature should affect the
12 distribution of aquatic life in the pond. The temperature decreases gradually
to approximately 35°C (94.5°F, at the pond outlet during average July
conditions as shown in Table 3.4-5 (Condenser Inlet Temperature). It is
1 anticipated that 65% of the pond surface area will have a temperature equal to
12 or less than the average July pond surface temperature of 38°C (100°F), (refer
to Table 3.4-5). Therefore, it is not expected during the summer season that
a substantial number of any fish species would flourish in the pond and those
3 introduced would likely be stressed by high temperatures. During the other
seasons, fish species that would probably inhabit the pond are carp,
catfishes, sunfishes and similar eurythermal warmwater species. In any case,

3 fish kill or stress of these species could be observed during either the warmest part of the year or when Plant operation is interrupted and fish become stressed by a sudden change in water temperature.

12 High levels of chlorine discharged into the pond could also contribute to fish stress in parts of the pond where heat-stressed fish are located. The amount of chlorine discharged intermittently into the pond will be maintained at
3 approximately 0.5 mg/l free available chlorine. No detectable chlorine level is anticipated to reach the cooling pond blowdown. During the fall and spring seasons, high temperature fluctuations due to condenser passage and increase of chlorine will tend to inhibit productivity.

In a 1979 report prepared by Lawler, Matusky and Skelly (LMS) Engineers[7], it was determined that algal blooms within the cooling pond should be of minor consequence. In addition, algae control should not adversely affect TDS concentrations. In summary, the LMS report indicated:

A comparison of chemical and biological data gathered from the pond and source
12 water with literature data concerning blue-green algal bloom requirements indicated that minor blue-green algal blooms can be expected in the cooling pond during the preoperational period. After the Midland Plant becomes operational, the water circulation in the pond and the high water temperatures predicted during the summer months should eliminate the occurrence of blooms. This prediction is based on the assumption that both nuclear units will be operating during these months. With one unit operating (Unit 2), blooms may occur during the warm weather months in the pond, with the exception of the discharge area. A bloom would be dependent on all conditions being conducive for its occurrence. Water circulation may lessen the intensity of the bloom.

This bloom would occur only for the one season that Unit 2 is operating alone. Mechanical harvesting may be the most appropriate means of controlling algae in the Midland pond. A modified Neuston net could be used to harvest the
12 minor blooms that are anticipated. TDS concentrations should not be increased. Ongoing pond studies will provide additional data regarding the status of bloom conditions and recommendations for control measures, if necessary.

3 The calculated increase of the Total Dissolved Solids (TDS) in the cooling water of the pond is expected to average 880 ppm with a maximum of 2,200 ppm (refer to Table 3.6-4). Assuming that dissolved solids existing in the river are relatively innocuous, the effect of increased TDS would be limited to
8 osmotic effects which are anticipated to occur only at concentrations of 5,000 ppm and above (refer to Section 5.3). The increased TDS levels in conjunction with heat loading could result in an increased productivity potential in the pond.

1 Chlorine in the cooling pond blowdown will be maintained within the NPDES Permit limits (refer to Section 5.1.1.3.1).

Zooplankton productivity in the pond is also dependent upon the phytoplankton population and will be controlled indirectly and directly by the same factors stated for phytoplankton.

During the months of normally low river flow and high ambient temperature when the influence on aquatic populations could be most severe. minimal makeup and
12 blowdown are anticipated.

5.6.3 Impact of Non-Radioactive Solid Wastes Produced During Plant Operation

Normal operation of the Midland Plant produces substantial quantities of certain non-radioactive solid wastes. Some are unique to the operation of a nuclear power plant, but most are common to any large-scale industrial operation. Improper handling or disposition of these wastes could cause adverse environmental effects.

Shipment of non-radioactive solid wastes offsite is contracted to licensed private refuse haulers. Disposal is in facilities, ie, sanitary landfills, operated by the City of Midland Public Works Department. Table 5.6-2 presents anticipated annual solid waste quantities and descriptions. These data were provided to the Midland Public Works Department for integration into their long-term projections of solid waste disposal needs for the Midland area and
12| no unusual adverse effects of this input were identified[8].

5.6.4 Noise

The ambient sound levels in the area of the Plant, especially the residential areas to the west and south, will not be increased by normal operation of the Plant. Ambient levels in the area tend to be high due to the presence of The Dow Chemical Company complex to the north. The only significant sound sources which will exist during normal operation are the transformers, vehicular traffic and service water cooling towers. Their projected sound levels are so low as to be completely masked by the existing background noises at the nearest noise-sensitive area. Background noise levels are in the "normally acceptable" category as set forth by the US Department of Housing and Urban
12| Development (HUD)[9]. Some variation exists between day and night background

levels but it is masked by the constant operation of equipment by The Dow Chemical Company as shown in Figure 2.7-2.

Other noise sources such as atmospheric dump valves, main steam safety valves and emergency diesels produce noise levels audible at the Plant boundary but only operate infrequently or under emergency conditions. The short duration
12| operation of this equipment ensures compliance with HUD and EPA[10] outdoor noise criteria for residential areas.

A prediction has been made of noise levels along site property lines, and in the adjacent residential communities resulting from the normal operation of the Midland Plant. The results of this prediction, along with methodology and supporting data, are shown in Appendix 5.6A.

5.6R REFERENCES

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3. Conversation between G A Dawson, Consumers Power Company, and Ralph
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12 4. Conversation between G A Dawson, Consumers Power Company, and G F Martz, Michigan Department of Natural Resources Waterfowl Specialist,
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12 5. Fish and Wildlife Service, Impact of Transmission Lines on Birds in
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6. Lenon, H L, et al, Survey and Evaluation of the Water Quality, Tittabawassee River Near Midland, Michigan, 1978-1979 (1979), Central Michigan University.

12 7. Lawler, Matusky and Skelly, Engineers, Preliminary Evaluation of Potential Blue-Green Algae Blooms and Control Methodologies (September 1979).

8. Letter from C R Miles, Midland City Manager to R W Montross, Consumers
1 Power Company, March 1, 1978.

9. US Department of Housing and Urban Development, *Noise Abatement and Control, Department Policy, Implementation Responsibilities, and Standards,* Circular 1390.2 (July 16, 1971), US Department of Housing and Urban Development, p 8.

12

10. Environmental Protection Agency, *Information on the Development of Environmental Noise Requirements To Protect Public Health and Welfare With an Adequate Margin of Safety,* EPA 550/9-74-004 (March 1974), Environmental Protection Agency, p 3.

5.7 RESOURCES COMMITTED

5.7.1 Land Resources

The land resources committed during the construction phase of the Midland Plant as described in Section 4.1 constitute the major environmental impact of
12 Plant development. No further land disturbance is expected to result from operation of the Midland Plant.

5.7.2 Fuel Resources

12 The operation of the Plant will involve the annual consumption of approximately 740,000 lb (16.25×10^6 kg) of uranium concentrate (U_3O_8). This quantity represents a small fraction of the available resources of the United States. Furthermore, the use of this fuel makes available the benefits of electric energy and avoids accelerating the depletion of fossil fuel resources.

5.7.3 Aquatic Resources

The aquatic ecology of the Tittabawassee River in the vicinity of the Plant is described in Section 2.2, and the impacts of Plant operation on the aquatic biota are discussed in Section 5.1.3. Irretrievable aquatic resources committed are limited to the entrainment and impingement losses of a small fraction of the plankton, ichthyoplankton, zooplankton, fish and macroinvertebrate populations in the river. Any such losses should be rapidly recovered
12 from the continuous drift in the river. In addition, plant blowdown may result in the return of aquatic resources. Based on the small proportion of river water being withdrawn for makeup (refer to Section 3.4), and the

12 intermittent nature of these withdrawals, a long-term negative impact is not foreseen.

No irretrievable losses of resources are anticipated to result from the thermal or chemical effluents of the Plant. The discharge from the Plant will not be continuous and any impact will be temporary and limited to the plume
12 area.

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6 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

Throughout this section, metric and English units are used where applicable. The appropriate conversion factors are:

1 millimeter = 0.04 inch

1 meter = 3.281 feet

1 mile = 1.6 kilometers

1 acre = 0.4 hectare

°C = 5(°F-32)/9

1 inch = 2.54 centimeters

6.1 APPLICANT'S PREOPERATIONAL ENVIRONMENTAL PROGRAMS

6.1.1 Surface Waters

Consumers Power initiated a preoperational monitoring program during April
12 1979 to be conducted for a minimum of two preoperational years. The program
is designed to identify the water quality and aquatic biota of the
Tittabawassee River in the vicinity of the Midland Plant and provide baseline
10 data for comparison with data obtained during postoperational programs. Since
the Applicant's construction permits were granted, the Tittabawassee River
12 watershed has experienced improvements such as: (1) wastewater control
10 systems, (2) reduced waste loadings, and (3) the relocation of the principal
wastewater discharge from The Dow Chemical Company, first across the river and
now 300 feet below the makeup intake of the Midland Plant. Water quality and
12 biological composition of the Tittabawassee River have improved in recent
years. This improvement is apparent in the comparison of studies conducted in
the early 1970s by The Dow Chemical Company[1,2] and the Michigan Department

of Natural Resources[3] with studies performed for Consumers Power Company in
12 the late 1970s by Central Michigan University[4,19], and current studies being
conducted by Lawler, Matusky and Skelly Engineers[20].

10

6.1.1.1 Physical and Chemical Parameters

Physical and chemical characteristics of the Tittabawassee River are monitored
in the vicinity of the Midland Plant. Sampling techniques, frequencies and
locations for each parameter are indicated in Table 6.1-1. Sampling locations
10 are illustrated in Figures 6.1-1, 6.1-1a and 6.1-1b.

All the analyses are conducted according to the Standard Methods[5] or US
12 Environmental Protection Agency (EPA) approved methods[5a]. Streamflow data
are obtained from the US Geological Survey (USGS) measurement station upstream
of the Plant (see Figure 2.4-3). Dissolved oxygen and water temperature data
from immediately below Dow Dam and near Freeland Bridge are obtained from
10 monthly operating data compiled by The Dow Chemical Company and submitted to
the Michigan Water Resources Commission (MWRC).

Deviations from the specified program are permitted if collections are
unobtainable due to hazardous conditions, malfunction of sampling equipment,
or human error. Every reasonable effort to complete collections should be
1 made prior to the next sampling period.

The applicant conducted a separate one-year water chemistry monitoring program for the Tittabawassee River. Water samples were taken on a monthly basis from August 1977 to July 1978 at The Dow Chemical Company dam in Midland, Michigan.
10 Results are shown in Table 3.6-3.

6.1.1.2 <u>Biological Parameters</u>

The preoperational environmental measurement program is designed to document the ecological characteristics of the Tittabawassee River in the vicinity of
10 the Midland Plant to provide a baseline for assessing effects of Plant operation.

10 Biological parameters monitored during the preoperational survey include phytoplankton, periphyton, zooplankton, macroinvertebrates and fisheries.

Deviations from the specified program are permitted if specimens are
10 unobtainable due to hazardous conditions, malfunction of sampling equipment or human error. Every reasonable effort to complete biological monitoring should
1 be made prior to the next sampling period.

6.1.1.2.1 <u>Entrainment Sampling for Fish Eggs and Larvae</u>

Fish eggs and larvae sampling at Midland commenced with the initial filling of the cooling pond. Triplicate entrainment samples were taken at the river
10 intake and the discharge pipe to the cooling pond using stationary drift nets. Both day (approximately mid-day) and night (approximately 2 hours after dark) samples were taken at least once each week during the initial filling

operations. Entrainment samples were taken from March 19 to May 4, 1978. Additional samples were taken on May 31, June 20, November 9 and November 16, 1978 to further evaluate the impact of entrainment.

Three metered No 2 plankton nets (351 μm mesh) were stretched on rectangular frames 22cm x 60cm. These net frames were then attached to a larger frame side by side, so that three replicate samples could be taken at the same time. Sampling at the river intake consisted of integrated vertical drift collections. At the discharge pipe to the cooling pond, samples were taken directly in front of the pipe outlet.

10

All samples were preserved in 10% buffered formalin in the field and returned to the laboratory for sorting, identification, enumeration and measurement. Fish eggs and larvae were preserved in 5% buffered formalin.

Since eggs could not easily be identified, they were categorized on the basis of their size groups (Type 1 = 0 8-1.4mm, Type 2 = 1.5-2.5mm, Type 3 ≧ 2.6mm).

Entrainment results were expressed on a day and night basis as number of eggs, larvae, and/or fry of each taxonomic category per 1000 m of water.

6.1.1.2.2 Impingement Sampling

10 Impingement of adult and juvenile fishes was anticipated to be minimal.
Therefore, an attempt was made to collect all fishes impinged during pond
12 filling. Screens were washed until clean, and the time of washing recorded.
The number of makeup pumps operating and duration of pumping were also

10 recorded. Fishes washed from the screens were collected in a basket (3/8-in mesh) in the sluiceway, emptied into labeled plastic bags and frozen.

Fishes were taken to the laboratory, thawed, sorted and identified to lowest practical taxonomic level. The total number, total weight (kg), and size range (mm) were obtained for each species. Total length (mm) and weight (g) measurements were made for not more than 25 individuals of each species
10 category. Subsampling was implemented during periods of heavy fish runs and included at least 10% by weight of the total amount impinged.

Impingement results were expressed as total number of fish impinged per volume of water pumped (1000 m) and per duration (hours) of pumping.

6.1.1.2.3 <u>Biological Sampling in the Tittabawassee River</u>

Sampling gear, locations, frequencies, number of replicates and number of
10 samples to be collected are indicated in Table 6.1-2. Sampling locations are identified in Figures 6.1-1, 6.1-1a and 6.1-1b.

6.1.2 <u>Ground Water</u>

12 Studies were undertaken to establish physical and chemical characteristics of the ground water at the Plant even though there is no projected use of ground water during Plant operation between the Plant boundaries and the Tittabawassee River. Ground water is put to nonpotable uses on site during construction (refer to Section 2.4.7.1.3). These studies provide for monitoring the Plant groundwater level and quality to detect any changes that
1 may be attributable to cooling pond operation. Negligible effect on the

groundwater environment, either from withdrawal or from seepage of Plant
effluents into the groundwater environment, is anticipated during normal
operation of the Midland Plant. No effect was detected as a result of initial
12 pond fill. Plant makeup and domestic water are not obtained from groundwater
sources. There are no controlled releases of Plant effluents to groundwater.
Seepage beneath the cooling pond is expected to be insignificant due to the
presence of the thick impermeable clay till described in Section 2.5.2.1.

The preoperational groundwater monitoring program was initiated prior to
12 construction. This program developed the groundwater information presented in
Section 2.4.7. The supplemental preoperational groundwater monitoring program
was implemented to provide additional baseline information during and after
the filling of the cooling pond and prior to Plant operation.

6.1.2.1 <u>Preoperational Groundwater Monitoring Program</u>

2 Water level data presented in Section 2.4.7 were determined from borings
drilled as part of the engineering and geologic investigations. Permeability
values for the underlying strata were computed from laboratory permeability
tests.

Yields, uses, locations, and depths of water supply wells within the region were determined primarily from government publications, and supplemented by a well survey program. Physical data on local water wells (within 3 miles of the Plant) were obtained by reviewing the files of the Michigan Geological Survey. Pertinent data from this review are presented in Table 2.4-9. Water wells within the site boundary (refer to Table 2.4-10) were located by site survey in conjunction with local water well drilling contractors. During the site investigation, 15 samples of ground water were obtained from domestic and

industrial water wells in the area. The chemical analysis of each water
2 sample is presented in Table 2.4-11.

6.1.2.2 Supplementary Preoperational Groundwater Monitoring Program

6.1.2.2.1 Description

The supplemental preoperational groundwater monitoring program is based upon
2 onsite observation wells and piezometers. A total of 19 observation wells at
12 eight locations and a total of 19 piezometers at two locations are installed
on the Plant site (see Figures 6.1-2 through 6.1-7).

2 Seven observation wells terminate in an upper sand aquifer, seven terminate in
an intermediate aquifer, and five terminate in an aquifer at a depth of
approximately 200 feet.

2 Piezometers have been installed either in or near the cooling water pond dike
to determine the piezometric level through the dike under various operating
conditions. The determination of the piezometric level monitors the performance of the chimney drains, the impervious cutoff trenches, and the slurry trenches. The general piezometer locations are shown in Figure 6.1-4, and are designated piezometer Sections P1 and P2. Section P1 (see Figure 6.1-5) is a typical high dike section with a compacted cutoff trench and Section P2 (see Figure 6.1-6) is a section through a slurry trench, which was required to seal off a sand zone. Section P2 is located adjacent to the Emergency Cooling Water Reservoir.

At each piezometer section (P1 and P2), piezometers are installed at four
points along the cross-section of the dike. The piezometer locations and the
2 depths of each piezometer tip are shown in Figures 6.1-5 and 6.1-6. Three

piezometer tips are installed at each of the two points in the dike and two
2 piezometer tips are installed at each of the two points near the outside edge of the dike. Each piezometer tip consists of either a Norton porous tube (medium grade) and 1/2-inch PVC open standpipe or a pneumatic type piezometer
2 tip with remote reading at the ground surface. Each piezometer tip senses the piezometric head in a specific soil layer, either within the dike itself or in the dike foundation material.

A typical piezometer installation sketch is shown in Figure 6.1-7. Each of
2 the piezometers was installed in a different hole. A galvanized metal pipe and sufficient guard posts were installed at each piezometer location.

6.1.2.2.2 <u>Groundwater Levels</u>

Groundwater level determinations are made at the observation wells and piezometers monthly from the time the wells and piezometers were completed until start of pond filling. During the initial partial pond filling, piezometers were read weekly or at two-foot increments of pond level,
2 whichever was more frequent. For the first five years of commercial operation, readings will be made monthly in the observation wells and piezometers. In addition, readings are made more often immediately after high floods, earthquakes or rapid drawdown of the cooling pond.

6.1.2.2.3 <u>Groundwater Quality</u>

Groundwater quality samples are taken from the observation wells. A minimum of two samples from each well were taken prior to pond filling, one sample was
12 taken after filling but before start-up, and thereafter one sample will be taken annually until initiation of the operational program. Parameters and

frequencies for groundwater analyses are presented in Table 6.2A-3-2 of the Environmental Technical Specifications.

6.1.2.3 Models

Groundwater modeling was not performed during the preoperational groundwater monitoring program and is not being employed for the supplemental preoperational groundwater monitoring program.

6.1.3 Air

6.1.3.1 Onsite Meteorological Measurements Program

The data collection period for the preoperational meteorological program was from March 1, 1975 to February 28, 1977. The data are presented in Section 2.3 and Section 5.2.2.0.

6.1.3.1.1 Meteorological Site Characteristics

Onsite meteorological data were collected from three different locations which are shown in Figure 5.2-10. These include a 91.5-meter tower and two satellite locations with 10-meter towers.

91.5-Meter Tower

The 91.5-meter tower is located northwest of a parking lot, about 1,150 feet west of the nearest containment (see Figure 5.2-10). The distances from the tower to the pond dikes are about 1,200 feet to the south and 1,050 feet to the southeast. The elevation of the top of the dike is 632 feet mean sea level (msl) and the elevation of the base of the tower is 614 feet msl. The grade level at the containment is at 634 feet msl. The top of the containment

is 787 feet msl. The tower provides the main meteorological records for the Midland Nuclear Plant.

Due to space limitation within the site, parking is allowed in an area in the northeast through south to southwest sectors, but this parking lot is separated by a fence from the general area surrounding the base of the tower. The distance from the tower base to the nearest car parked just outside the fence is approximately 130 feet. The ground area within the fence is primarily clay.

North Station

This tower was located on the bank of the Tittabawassee River about 800 feet northeast of the containment. The tower provides meteorological data for winds from the northeast quadrant after they have traversed The Dow Chemical Company plant and the Tittabawassee River. The base of the tower was 600 feet msl. The water elevation in the Tittabawassee River is estimated to be 590 feet msl about 50% of the time.

South Station

This tower was located about 6,600 feet south of the containment and about 400 feet south of the cooling pond dike. This tower provides information for southerly wind components before they traverse the area now occupied by the cooling pond. The elevation of the base of the tower is 628 feet msl. The elevation of the top of the dike, 400 feet to the north, is 632 feet msl.

6.1.3.1.2 Meteorological Data Acquisition System

Instrumentation for 91.5-Meter Tower -- The meteorological variables measured on the 91.5-meter tower were:

10-meter level	WS, WD, AT, DW, SG
40-meter level	WS, AT, DW
60-meter level	WS, WD, AT, DW, SG
91.5-meter level	WS, WD, AT, DW

where

WS = wind speed

WD = wind direction

AT = ambient air temperature

DW = dew point

SG = wind direction fluctuation (standard deviation)

Table 6.1-3 shows the quantity, manufacturer, model number, and the specifications of the sensors used on the tower. All wind direction and speed sensors are mounted at least two tower widths from the tower and each wind sensor is six feet or more from any other sensor. Temperature and dew point sensors are at least one tower width from the tower.

An EG&G digital system converts the sensor output signals into engineering units for each parameter on the 91.5-meter tower. Delta temperature (ΔT) is determined by internal electronic subtraction of temperature sensor signals from two different tower levels. The digital system includes an Interdata Model 7/16 processor of 32K byte memory module and 16 general registers. The processor polls the sensor signals 16 times per minute and prints the average value for the last 15 minutes of each hour. Data averaged for this 15-minute

period represent the hour and are used in subsequent data analysis. Hourly records are automatically listed on an ASR-33 teletype printer and recorded on a nine-track 800 BPI magnetic tape. Therefore, a digital paper printout record of each hourly value of each parameter is available for inspection and the same information is compiled on magnetic tape for computer applications.

Nine dual-channel strip chart recorders (eight Esterline Angus Model L1102S and one Esterline Angus Model L1101S) were utilized to produce analog records of the measured variables as backup to the digital system. Instead of recording the ambient air temperature measured at the 91.5-meter, 60-meter, and 40-meter levels, the temperature differences ΔT(10-40), ΔT(10-60), and ΔT(10-91.5) were recorded on the strip charts, along with the temperature at the 10-meter level. The full scale of the ΔT parameter is 10°C and each analog recorder had a 10-inch wide chart running at a speed of 4 inches per hour. The direct recording of temperature difference provided an accuracy of within ±0.10°C.

All data receiving and recording equipment for the 91.5-meter tower was located in an environmentally controlled structure at the base of the tower. The accuracy of a measured variable depends upon the sensor, the electronics, and the recording equipment used. The overall system accuracies of the measured variables on the 91.5-meter tower are listed in Table 6.1-3.

Instrumentation for North and South Stations

Each 10-meter tower station had instrumentation to measure wind speed, wind direction, ambient air temperature, and relative humidity. Table 6.1-4 shows the quantity, the manufacturer, the model number, and the specifications of the sensors used at each of the 10-meter tower stations. The wind speed

(Climet WS-011-1) and wind direction (Climet WD-012-30) sensors were 6 feet apart on top of the 10-meter tower. A Climet Model 025-9 weatherproof portable (battery powered) translator was used in the wind measurements. An Esterline Angus Model A601C recorder provided the analog records of the wind speed and direction measured at each 10-meter tower. The recorder used a 6-inch wide chart paper running at a speed of 3 inches per hour. The translator and the analog recorder were housed in an environmentally sealed enclosure (36" x 30" x 16").

The ambient air temperature and relative humidity at each 10-meter tower station were measured and recorded by a Science Associates, Inc 255 hygrothermograph. The recorder drive was spring driven and could run for a period of eight days. The hygrothermographs were housed in a Weather Measure IS1 instrument shelter which was located in the vicinity of the 10-meter tower.

No automatic digital data acquisition equipment was used to record data for the two 10-meter tower stations.

The overall accuracies of the wind speed, wind direction, air temperature, and relative humidity measured at each of the 10-meter tower stations are listed in Table 6.1-4.

6.1.3.1.3 Calibration

Every six months all sensors, electronics, and recording equipment were calibrated. Additional onsite calibrations were performed during the service visits as required in Section 6 1.3.1.4. Any necessary adjustments were made on site and equipment which malfunctioned was either corrected on site or

replaced with similar spare equipment. After any major adjustments or repairs, the calibration was repeated.

91.5-Meter Tower Equipment

The Rosemount temperature sensors were sent to the manufacturer for calibration where they were immersed in a constant temperature bath and the resistance reading of the sensor was recorded for the ice point and other calibration points. The dew point sensors were calibrated on site per manufacturer's specifications using precision test equipment. Known resistance values from a precision decade resistance box were applied as input for calibration of the dew point control unit. The wind speed cups were returned to the manufacturer for calibration. The wind speed transmitter bearings were replaced and functional electrical checks performed. The wind direction transmitter was visually inspected and the bearings were replaced. The transmitter was electrically checked and placed in a polar coordinate jig which allowed output voltage readings to be taken every 10 degrees. The data were listed and checked for linearity. The wind direction vanes were visually inspected and replaced if bent, damaged, or unbalanced.

The electronics calibrations were performed by simulating the output of each of the sensors with precision test equipment and monitoring the recorded values for each parameter. Wind speed sensors were replaced during calibration by a frequency generator which was adjusted to provide frequencies corresponding to known wind speeds. Wind direction sensors were replaced by a stable voltage source which was adjusted to provide an output corresponding to known wind vane orientations. Temperature sensors were replaced with a stable decade resistance box which was adjusted to provide accurate resistances

corresponding to known temperatures. The test instrument settings used were those for which the sensor manufacturer published calibration equivalents. Chart recorders were checked for zero and span calibration points during routine site operation checks and a linearity check was performed every six months. The digital and analog records were compared during the system calibration and adjustments made where required in accordance with manufacturer's procedures.

Corrections were applied to the data collected between calibrations, if needed. If the error was obviously connected to a specific event, a constant correction was applied from that event to the last calibration. If no event was discernible, a linear interpolation of the error from 0% of error at the previous calibration to 100% of error at the last calibration was applied. If a correction could not be determined, the data were considered bad and were not used.

Remote Site Equipment

The Climet wind speed and wind direction transmitters were rebuilt by replacing the bearings and performing electrical checks per the manufacturer's procedures. Wind speed cups were sent to the manufacturer for calibration against a standard in a wind tunnel. Wind vanes were inspected and replaced if bent, broken, or unbalanced. The sensor outputs were electrically simulated with a calibration unit to check the electronic signal conditioning equipment. Recorders were checked for linearity and zero and span adjustments.

The hygrothermograph air temperature and relative humidity units were checked against a psychrometer at least once a month and were rotated in use with a spare unit for calibration adjustments per manufacturer's procedures.

6.1.3.1.4 Service and Maintenance

Weekday visits to each meteorological station were made by a full-time technologist in accordance with the site operating procedures. These checks included visual inspection of sensors on the tower, checking inkwells and pens, changing chart paper, and inspecting the analog chart data record and digital data printout to determine correct system operation. In addition, time marks were applied to strip charts and the digital time checked. At least once a month the towers were climbed for visual inspection of the sensors and preventive maintenance.

6.1.3.1.5 Data Reduction Procedures

The data reduction procedures discussed in this Section were those used for the data presented in this report which includes data from the 91.5-meter tower, the north 10-meter station, and the south 10-meter station.

The data acquisition system utilized four levels of instrumentation (10-meter, 40-meter, 60-meter, and 91.5-meter) on the 91.5-meter tower. Additional data were available from the north and south stations. The various levels of instrumentation on the 91.5-meter tower provided onsite data for χ/Q modeling. The atmospheric stability conditions were determined from the temperature difference (ΔT) between the 10-meter and 60-meter temperature measurements, in accordance with the Pasquill Stability Criteria, as outlined in Regulatory Guide 1.23[6]. Data from the 91.5-meter tower from March 1, 1975 to

February 28, 1977 were recorded on magnetic tape as the primary record. Analog strip charts were used as backup and read when required to fill in missing data points due to magnetic tape system outages. When backup data were read from charts, they were put on coding forms, keypunched, and merged with the site magnetic tape data onto a new tape or disk. A data listing from the processed magnetic tape record containing all the data recorded was made for checking purposes. Diagnostic and check computer programs were then run on the composite data. A final processed data tape was then made and stored for use in running the various modeling programs.

The data from the north and south stations were all recorded on analog charts which were manually read and the data put on coding forms. After keypunching and editing, the processed data were put on magnetic tape or disk for storage and used for the various report requirements.

6.1.3.1.6 Meteorological Data Recovery

The meteorological data recovery rates for each parameter are listed in Table 6.1-5. The joint frequency data recovery for 10- to 60-meter temperature difference, 10-meter wind speed, and wind direction for the March 1, 1975 through February 28, 1977 period was better than 94%, meeting the 90% data recovery goal required by Regulatory Guide 1.23[6]. These joint frequency data were the primary data used to compute χ/Q values in Sections 5.2.2.0.1 and 5.2.2.0.2.

6.1.3.1.7 Joint Frequency Distributions of Wind Direction and Speed by Atmospheric Stability Class

Joint frequency distributions of wind direction and wind speed by atmospheric stability class on a seasonal and biennial basis for the period March 1, 1975

to February 28, 1977 are provided in Appendix 2.3A. Appendix Tables 2.3A-1 through 2.3A-5 provide the joint frequency distributions for data from the 10-meter wind speed and wind direction and the temperature difference between 10 meters and 60 meters; Appendix Tables 2.3A-6 through 2.3A-10 provide the joint frequency distributions with 60-meter wind speeds and wind direction and temperature difference between 10 meters and 60 meters.

2 6.1.3.1.8 Fog and Ice Monitoring

12 A five-month visual observational program was conducted between November 1978 and March 1979 to determine the location and number of fog visiometers needed for the two-year preoperational study.

10

A two-year preoperational fog and ice monitoring program began in October 1979 in the vicinity of the Midland Plant cooling pond. This study will document 2 the occurrence of background fog and icing prior to the operation of the Plant.

The monitoring program uses a combination of visual observations and recording instruments. An MRI Model 1580 fog visiometer was installed and will operate 10 at each of two locations around the cooling pond; one on the east side of Poseyville Road at the entrance to Consumers' laydown area and the other at the Tittabawassee Substation near Mapleton Village. An inventory of spare parts will be maintained on site in order to minimize downtime and consequent 2 loss of data. Since the pond will not dissipate any heat from the Plant during this preoperational period, the visual observations will be taken from the beginning of October to the end of March.

Trained onsite observers will routinely check the visiometers and take visual observations during the day covering the period from dawn to dusk using accepted meterological observing techniques. The observations will be taken at a number of predesignated fixed points as well as other points depending on prevailing meteorological conditions. For visibility measurements, markers will be designated or erected for quantitative and objective substantiation. For icing observations, pairs of stakes will be erected at different distances
2 and orientations from the pond. One of the pair of stakes will be used for determining the degree of current icing, while the other will be used to determine the cumulative effect. Ice on existing objects, such as fences and foliage as well as ice on roadways, will also be included in the icing observations.

The observations will be logged by the observers on a specially prepared form. A camera will be used for photographic recording of special conditions. Each photograph will be indexed to the appropriate observation.

6.1.3.2 Models

The atmospheric transport and diffusion models and the estimate of χ/Q are presented in Section 5.2.2.0.

6.1.3.3 Preoperational Noise Survey

During May of 1973, an environmental sound survey was conducted in the area of the Midland Plant and surrounding property. The survey provided baseline environmental noise levels for the area surrounding the Plant prior to construction such that the noise impact of construction and operation could be

determined. The baseline data collected in this survey are presented in Section 2.7.

11 Another survey will be conducted in the year prior to commercial operation, when most Plant construction is complete, following the same procedures and techniques as used in the 1973 survey. At that time, any additional ambient noise sources, such as those from The Dow Chemical Company complex, the major source of noise in the 1973 survey, can be identified.

6.1.3.3.1 <u>Instrumentation</u>

The following equipment was used in the May 1973 ambient sound level survey of the Midland Plant site:

a. General Radio Model 1558-BP Octave Band Analyzer
b. General Radio Model 1560-P6 1-Inch Ceramic Microphone
c. General Radio Model 1560 - P40 Microphone Preamplifier
d. General Radio Model 1562A Microphone Calibrator
e. Bruel and Kjaer Windscreen

The Octave Band Analyzer (sound level meter) used conforms to ANSI Standard S1.4-1971[7] for a Class II sound level meter which complies with ANSI Standard S1.13-1971[8], Section 5.4.1, concerning instrument accuracy for field environment use.

11 In future environmental noise surveys at the Midland Plant site, the following general equipment specifications will be adhered to:

a. Sound Level Meter - conforms to ANSI Standard S1.4-1971[7] for a Class I Precision Sound Level Meter.

b. Octave Filter Set - conforms to ANSI Standard S1.11-1966 (R1971)[9] for octave, half octave, and third octave filters. The filter set can be a part of the Precision Sound Level Meter.

c. Microphone - conforms to ANSI Standard S1.4-1971[7] and satisfies the requirements of the Class I Precision Sound Level Meter. A windscreen was used to minimize the effect of wind noise.

d. Calibrator - capable of calibrating the sound level meter used.

Other general equipment will be required:

e. Tape Recorder - will be used when a nonrepeatable, short duration noise is to be measured. Tape recorder will meet specifications set forth in ANSI Standard S1.13-1971[8].

f. Temperature, humidity and wind speed measuring equipment. Barometric pressure will be obtained from the nearest airport.

g. Measuring Tape or Measuring Wheel - for determining distances to locate data collection points.

6.1.3.3.2 Calibration

The system was calibrated prior to each measurement period to ensure consistent and accurate measurements. Battery condition was monitored and batteries replaced when necessary. These procedures will be followed in all
11 future sound level surveys at the site.

6.1.3.3.3 Methodology of Data Collection

During the May 1973 environmental sound survey, "A" weighted and/or octave band measurements were taken at 13 locations in the area of the Midland Plant

structures and the perimeter of the Plant property boundary. Measurements were taken at the nearest residence as well as along the access roads to the Plant. Measurements were taken during three different time intervals over a 24-hour period; (1) the first period (1630 to 1930 hr) encompassed the highest ambient noise time period in the general vicinity of the Plant due to the elevated levels of traffic noise on adjacent roads; (2) the second period (2100 to 2300 hr) was chosen as typical of those hours when the majority of persons residing near the Plant would be active within their homes and levels of ambient sources other than the Midland Plant would be minimal; (3) the third period (0300 to 0500 hr) represented the extreme condition when virtually all community noise should be at its lowest value. The number and location of sampling points and the sampling periods were chosen to provide an accurate measure of existing ambient levels. Sound level measurements were taken with the sound level meter in the slow-response position. Each measurement represents a 15-second average of the sound level meter indication. During each measurement, weather data and general traffic conditions were observed and recorded. A B&K Windscreen was always used on the microphone. However, no data were collected when the wind velocity exceeded 10 mph.

12 Essentially the same procedure will be followed in the ambient survey performed just prior to commercial operation with the exception that a number of measurement points will be added to the existing 13, in the area north of the Plant extending into The Dow Chemical Company complex, and beyond the Plant property lines to the south and west to include the residential areas nearest to the Plant.

In addition, the amount of data taken at each measurement point will be expanded by recording a sample of the ambient sound level and subsequently analyzing this sample on a real-time analyzer. Not only will this provide a permanent record of the data, but will allow more meaningful comparisons to be made between data points and between preoperational and postoperational levels. Due to the industrial nature of the area directly north and east of the Midland Plant, it is also expected that the noise impact of the Midland Plant will be difficult to quantify without a spectral analysis of the sound levels at these points. The recording and real-time analysis of these measurements will greatly enhance the accuracy and reliability of the data.

1 | 6.1.4 Land

6.1.4.1 Geology and Soils

Numerous site exploration programs have been completed since the initial investigation began in 1956. The primary purposes of these studies were to determine the site glacial and bedrock geology conditions, evaluate the foundation conditions, and determine the environmental impact of Plant construction and operation on the geology and soils in the Plant area. The major conclusions of these investigations are presented in Section 2.5. These programs are summarized in the following sections.

6.1.4.1.1 Exploration Programs

Power Block Area Borings

A total of 117 borings ranging up to 432 feet in depth and 22 probes were performed in the power block area between 1956 and 1974. Two of the borings passed through the glacial deposits and penetrated into rock. Boring 1 was

drilled about 10 feet into rock, and Boring 1A was drilled about 75 feet into rock.

Twenty-two probes ranging in depth from 10 to 45 feet were also performed in this area by truck-mounted rotary continuous flight auger equipment. The soil cuttings from the augers were used to identify soil types for the log of the soil profile.

Dike Perimeter Area Borings

A total of 167 borings are attributable to exploratory work for the dike system. Sixty-one of the borings were done for site exploration and the rest were subsequently drilled in conjunction with dike construction. The borings ranged in depth from 3.5 to 70 feet.

Borrow Area Borings

A total of 90 borings were made in the borrow area inside the dike system. Twenty-one of the borings were made in the area that is now the emergency cooling water pond. These borings range in depth from 10 to 15 feet.

Forty-nine borings were drilled at various locations within the cooling pond area to determine a source of borrow material. They ranged in depth from 5 to 60 feet.

Borings for Structures Outside Power Block Area

Additional exploration was conducted for three structures away from the main Plant area. Nine exploratory borings were drilled at the railroad bridge site and one in the embankment area. These ranged in depth between 25 and 70 feet. A total of eight borings with depths ranging from 60 to 75 feet were made in

the vicinity of the Bullock Creek bridge. Sixteen borings ranging in depth between 9 and 60 feet were made in the vicinity of the spillway through the east leg of the dike.

6.1.4.1.2 Soil and Rock Sampling Methods

No preoperational studies have been conducted to determine the impact of construction activities on productivity of soils; however, the surface soil types that are found on the site have been discussed in the Ecological Survey of the Midland Site[10].

Physical properties of the glacial surficial materials were determined. Both disturbed and undisturbed soil samples were taken. The disturbed samples were of three types: those from the standard penetration test sampler, bulk samples from auger cuttings, and wash samples from the rotary wash drilling process. The undisturbed samples were obtained by using Dames and Moore soil samplers or coring methods.

The rock cores were taken by an NX size core barrel with a diamond bit.

6.1.4.1.3 Subsidence Monitoring Program

The subsidence benchmark program is designed to monitor any subsidence of the
2 | ground surface which could occur adjacent to the Plant due to salt mining. The program is considered as precautionary because no actual subsidence is anticipated as a result of the salt mining.

Two studies, one of which includes 10 years of ground surface monitoring data, prepared by independent engineering consulting firms and referenced in Section 2.5 of this report, conclude there will be no surficial effects due to salt

removal from the rock strata located over 4,100 feet beneath the ground surface. Since the issuance of these reports, a number of previously active wells used in the subsidence analysis have either been plugged or are now inactive (see Table 2.5-1 and Figure 2.5-5 for status of all salt, brine and
12 injection wells within one mile of the Midland Plant).

The subsidence monitoring system consists of 25 shallow benchmarks anchored in
2 till at a depth of 15 to 60 feet (4.5 to 18 m) below the ground surface and 2 deep benchmarks anchored in rock 320 and 413 feet (98 and 126 m) below the ground. Figure 6.1-8 shows the location and design of these benchmarks.

2

First order surveys will be made at least annually for the operational life of the Plant to detect any subsidence near the Plant.

6.1.4.2 <u>Land-Use and Demographic Surveys</u>

Land-use information and data were obtained by the Applicant's staff from field surveys of the area surrounding the Midland Plant site, and from the Environmental Inventory(11).

Recent aerial photographs were used to locate the nearest residence in each of the 16 sectors. Consumers Power Company's Electrical Service Distribution maps were used to verify these residences. The nearest vegetable gardens were assumed to be located at the nearest residences. Field surveys of the area within 5 miles of the Midland Plant consisted of driving all the public roads to physically locate the milking cows, milking goats and also to verify the nearest residences.

Methods for collection and analysis of demographic data are discussed in Section 2.1.2.

6.1.4.3 Ecological Parameters

The 1971 terrestrial ecological survey[10] that was conducted by Michigan State University personnel is the only terrestrial ecological survey that has been completed on the Midland Plant site. The report described and discussed relationships between the vegetation and wildlife that existed on the site
3 prior to and after preliminary Plant site preparation activities. Most of the vegetation and wildlife habitat on the 1235-acre Plant site have been either eliminated or altered as a result of construction activities.

An ecological survey of the Midland Plant's proposed 345 kV transmission line
10 right-of-way was initiated on September 20, 1978 and completed on
12 September 14, 1979 (final report November 10, 1979)[21]. The scope of this study for the transmission line right-of-way included analyses of:

a. soils
b. vegetation (taxonomic and phytosociological)
3 c. avifauna during migratory periods and the breeding season
d. mammalian fauna
e. reptiles and amphibians

The study was designed to emphasize those species recognized as "important" species[18].

10

Additional terrestrial ecological studies in the Plant vicinity were initiated in the preoperational phase in April 1979 and will continue into the operational phase. These studies address the following potential impacts:

7 a. effect of the cooling pond, Plant and associated facilities on avifauna, principally ducks, geese, gulls, and shorebirds, and their potential impact on Plant operations

12

Preoperational avifauna studies focus on the numbers and species composition, and usage characteristics of waterbirds using the pond and potential impacts, such as collisions with transmission lines. The present study scope has been designed to adequately address any
10 potential impact from the operation of the cooling pond. However, the study may be expanded if potential impacts identified in Section 5.6.1 occur or appear imminent.

7 b. physical damage to vegetation during the winter months caused by
10 freezing moisture vapor from the cooling pond

7 Preoperational vegetation studies will establish baseline levels of
10 vegetation damage in the vicinity of the Plant. Data from preoperational studies will provide a data base for operational
7 studies, the technical specifications for which are detailed in Section 6.2A-3.1.2.2.

6.1.4.4 Archeology

An archeological survey of the Tittabawassee - Kenowa/Thetford transmission line right-of-way was conducted in 1977. Methodology and results are
5 presented in the survey report (Appendix 2.6C).

The archeological resources of the Tittabawassee River floodplain at the Plant were investigated in 1978. Previously located sites on the Plant property were identified and the archeological background and historical background of

the Plant area were determined. Surface surveys of the floodplain were conducted in about 10-meter (33-foot) transects and shovel testing at random. Drainage ditches and the exposed banks of the Tittabawassee River were also inspected. Seven backhoe trenches were excavated at likely sites into the floodplain deposits. This deep testing was to investigate the possible
5 presence of archeological materials buried under alluvial deposits. Complete descriptions of methodologies and results are contained in the report, Archeological and Historical Investigations of the Floodplain Area, Midland Plant Site, Midland, Michigan, copies of which have been provided to the Nuclear Regulatory Commission.

6.1.5 Radiological Monitoring

Radiological environmental monitoring at the Midland site has previously been described in numerous documents. This program is presented in Table 6.1-6 and was proposed and revised during the late '60s and early '70s. At that time neither definitive Atomic Energy Commission guidelines for environmental monitoring nor the quantification of an As Low As Reasonably Achievable exposure program existed. A new program designed along NRC guidelines[12] and a more complete knowledge of anticipated radioactive effluents and resultant doses is presented in Table 6.2a-3-9.

7 The radiological environmental monitoring program (refer to Table 6.2a-3-9) is therefore designed to detect and measure environmental concentrations resulting from radiological discharges from the Midland Plant. The program consists of two phases, a preoperational and an operational phase. Both phases use an environmental sample collection and analysis program coordinated

with effluent monitoring to determine individual and population radiation doses beyond the site boundary.

7

The preoperational phase will determine the level of naturally-existing radionuclides in the environment surrounding the Plant. These levels, if determined to be relatively stable, can then serve as a basis for comparison with levels obtained once the Plant is operational. Additional objectives of the preoperational phase are verification of the suitability of analysis methods, sampling sites, sampling collection procedures and techniques of data analysis as well as the training of personnel.

An analysis of both the aquatic and terrestrial environments has been made identifying critical food pathways (refer to Section 5.2). Consumption of fish taken from the Tittabawassee and the Saginaw Rivers and consumption of Saginaw Bay water are the critical pathways for population radiation exposures for effluents discharged to the aquatic environment. The critical pathways for the terrestrial environment are direct dose from noble gas releases, consumption of leafy vegetables by a child and infant milk consumption.

Sampling media to be collected, sample locations, frequency of collection and
7 analysis and bases for collection are shown in Table 6.2A-3-9 and Figure 6.1-9. The exact location of all sampling locations has not yet been determined. These locations will depend on the most recent demographic survey, availability of power supply and owner approval for all offsite locations when the preoperational phase begins in accordance with the schedule presented in Table 6.1-8.

7 Table 6.2A-3-10 contains the lower level of detection for the various sample
media and radionuclides. These levels are all within those concentrations
that, if continuously present in a particular media, would not result in doses
to the general population greater than the design objective-dose equivalent
prescribed in Appendix I to 10 CFR 50.

Air sampling locations were selected on the basis of annual average ground
level χ/Qs. The three site boundary locations are in the prevailing wind
7 direction downwind of the Plant. The North sector location was selected on
the basis of population weighted χ/Q values. The South sector location is for
control purposes only.

7 Two surface water samples will be collected monthly during the preoperational
and operational phase, one each, upstream and downstream of the discharge.
The closest municipal water intakes are all located in Saginaw Bay
approximately 40 river miles away; composite samples will be taken monthly
7 from the two water supplies.

Sediment samples will be collected semiannually, as will fish samples when
available, during both the preoperational and operational phase. Edible
7 vegetation will be collected monthly during the third quarter on an
as-available basis from three sample locations and one control location.
Consistent with regulatory guidelines, no milk samples will be collected since
this pathway has a calculated annual dose of less than one millirem.

Deviations from the specified program are permitted if specimens are unobtainable due to hazardous conditions, unavailability or due to malfunction of sampling equipment. Every reasonable effort to complete corrective action
7 related to sampling equipment failure will be made prior to the end of the next sampling period.

TABLE 6.1-1

PREOPERATIONAL PHYSICAL AND CHEMICAL PARAMETERS
MONITORED IN THE TITTABAWASSEE RIVER

PARAMETER	FREQUENCY	TECHNIQUE	SAMPLING LOCATIONS
Temperature	Continuous[a]	Continuous monitoring probe (Dow's)	1) near Steam Line Bridge 2) near Freeland Bridge
	Quarterly, during biological monitoring[a]	electronic temperature probe	1) biological monitoring locations 2) Dow discharge 3) Lingle drain
Dissolved oxygen	Continuous	continuous monitoring probe (Dow's)	1) near Steam Line Bridge 2) near Freeland Bridge[b]
	Quarterly, during biological monitoring[b]	electronic DO probe	1) biological monitoring locations 2) Dow discharge 3) Lingle drain
pH Conductivity Turbidity	Quarterly, during biological monitoring[b]	40 CFR 136 methods	1) biological monitoring locations 2) immediately above Dow Dam 3) Dow discharge 4) Lingle drain
Alkalinity, total Calcium, total Magnesium, total Sodium, total Potassium, total Sulfate, total Nitrite-Nitrate Nitrogen Ammonia Nitrogen Copper, total Zinc, total BOD (5) Phosphorus, Total	Quarterly during periphyton and macroinvertebrate sampling	40 CFR 136 methods	1) periphyton and macroinvertebrate monitoring locations 2) immediately above Dow Dam 3) Dow discharge 4) Lingle drain
Total filterable residue Total nonfilterable residue Silver, total Mercury, total Lead, total	Quarterly	40 CFR 136 methods	1) immediately above Dow Dam 2) near Freeland Bridge

(a) Dow's continuous monitoring probe.

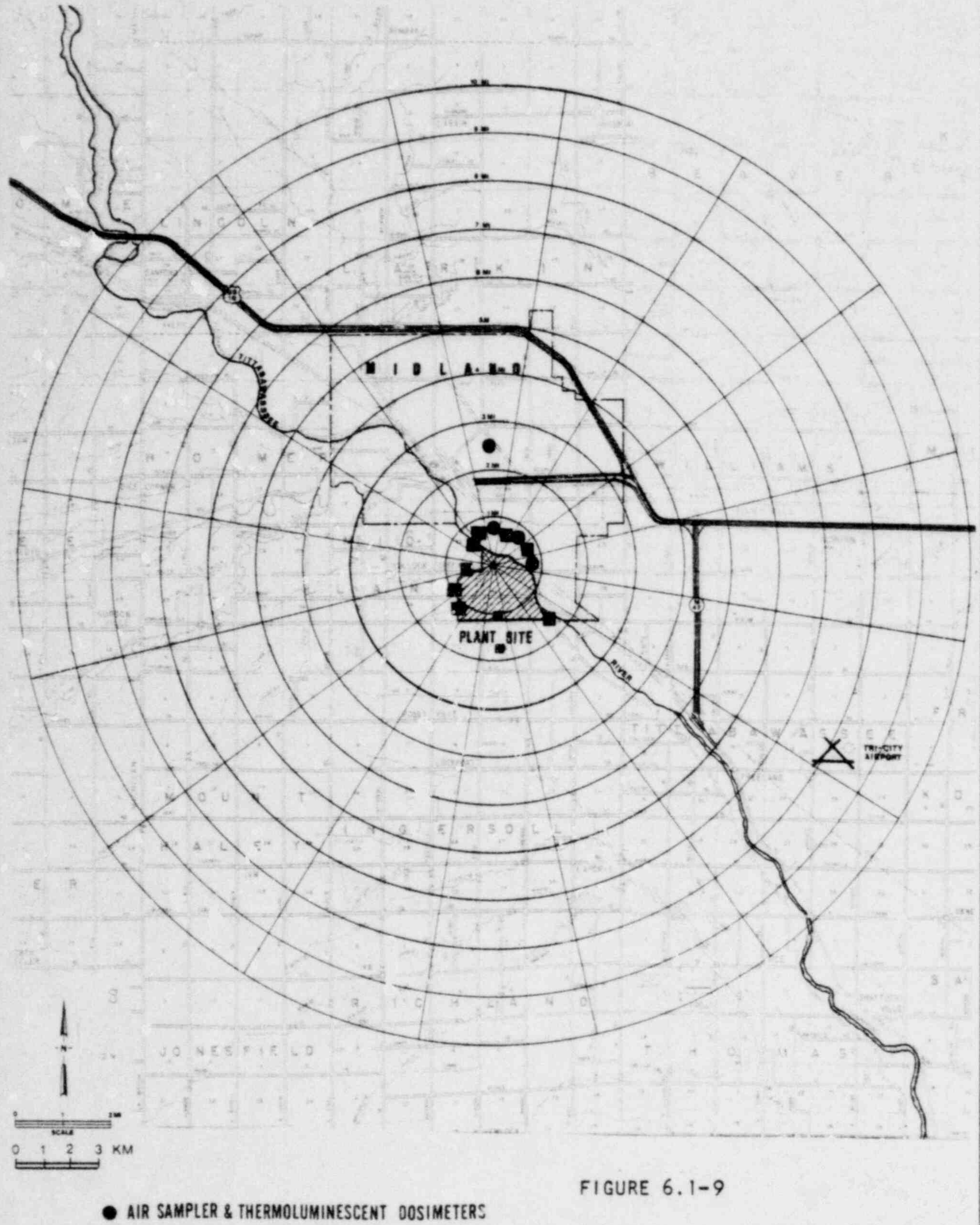
(b) Biological monitoring is defined as periphyton, macroinvertebrates, fisheries and ichthyoplankton sampling (see Table 6.1-2).

TABLE 6.1-2

PREOPERATIONAL BIOLOGICAL PARAMETERS MONITORED IN THE TITTABAWASSEE RIVER

Parameter	Gear	Locations[a]	Replicates	Frequency	Number of Samples
Phytoplankton	Van Dorn	A_2 D_2	2	April, June, August, October	16
	Periphytometer II	3/Transect Transects A/B/C/D/E	2	April, June, August, October	120
Periphyton	Natural Substrate	2/Transect Transects A/B/C/D/E	1	April, June, August, October	40
Zooplankton	64μ Net Oblique Tow	A_2 D_2	2	April, June, August, October	16
	Artificial Substrate	3/Transect Transects A/B/C/D/E	2	April, June, August, October	120
Macroinvertebrates	Triplex Ponar	3/Transect Transects A/B/C/D/E	2	June, August October	90
		A_4, A_6, A_7, A_8, B_4, B_5, C_4, C_6, D_4, D_6, E_4, E_6	1	Monthly, March through November	108
10	Electroshock	8 Locations from Sanford Lake to Saginaw Bay	1	Bimonthly, September through Mid-December	56
	50' x 6' x 1/4" Bag Seine	A_4, A_6, B_4, B_5, C_4, C_6, D_4, D_6, E_4, E_6	2	Monthly, March through November	180
	Electroseine	3/Transect Transects A/B/C/D/E	1	Once during a low flow period	15
	Hoop Net	A_4, A_6, A_4, C_5, C_4, C_6, D_4, D_5, D_6, E_4, E_5, E_6	1	April, June, August, October	48
	Larval Seine 25' x 6' x 1/16"	A_4, A_6, B_4, B_5, C_4, C_6, D_4, D_6, E_4, E_6	1	During daytime ichthyoplankton sampling periods	260
	1/2 m Diameter 351 μ Net	A_1, A_2, A_3	2	Weekly April through August, Bimonthly through August Day and Night	312
	Oblique Tow	Sanford Lake, Pine River, Chippewa River, Mouth of Saginaw Bay	2	Weekly, April and May	64
Fisheries	Neuston Net	A_1, A_2, A_3	2	Weekly, April through August, Bimonthly through October, Day and Night	312

(a) Sampling locations are shown on Figures 6.1-1a and 6.1-1b.



● AIR SAMPLER & THERMOLUMINESCENT DOSIMETERS

■ THERMOLUMINESCENT DOSIMETERS ONLY

CONTROL AIR SAMPLER & TLD LOCATED
12 MILES SOUTH SECTOR

18 MILES SW SECTOR (TDL ONLY)

FIGURE 6.1-9

RADIOLOGICAL ENVIRONMENTAL SAMPLING LOCATIONS WITHIN 10 MILES

MIDLAND PLANT UNITS 1& 2

CONSUMERS POWER COMPANY

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6.2 APPLICANT'S PROPOSED OPERATIONAL MONITORING PROGRAMS

Deviations from the specified program are permitted if collections are
10 unobtainable due to hazardous conditions, malfunction of sampling equipment or
human error. Every reasonable effort to complete collections should be made
1 prior to the next sampling period.

6.2.1 Surface Waters

Operational surface water programs identify effects of Plant operations on the water quality and aquatic biota of the Tittabawassee River. These programs are designed to provide data for comparison with those obtained in the preoperational programs described in Sections 6.1.1.1 and 6.1.1.2, for documentation of National Pollutant Discharge Elimination System (NPDES) Permit compliance, and for furthering the understanding of the processes involved in the improving conditions of the Tittabawassee River. The preoperational and operational programs are similar to provide comparable data
and the operational program will satisfy NPDES Permit requirements. The State
10 NPDES Permit Application was submitted in February 1978 and amended in
November 1978 and June 1979.

6.2.1.1 Physical and Chemical Parameters

The preoperational program is described in Section 6.1.1.1 and is to be
10 continued on that basis with additions as necessary to comply with NPDES
Permit requirements. Results of the preoperational program may dictate changes in this operational program.

6.2.1.2 Biological Parameters

The preoperational program described in Section 6.1.1.2 will be continued on
10 that basis with additions as necessary to comply with NPDES Permit requirements. Results of the preoperational program may dictate changes in this operational program.

10

6.2.2 Ground Water

The operational groundwater program provides assurance that the impervious clay bottom of the cooling pond and the construction of the cooling pond dikes prevent seepage into aquifers outside the cooling pond boundaries. Results of this program will be compared to those of the preoperational program described in Section 6.1.2. A thorough description of the operational program is presented in Section 6.2A-3.1.1.2.2 of the Environmental Technical Specifications.

6.2.3 Air

6.2.3.1 Meteorology

6.2.3.1.1 Operational Meteorological Monitoring Program

The operational meteorological program for the Midland Plant provides:

a. Meteorological data to estimate short-term diffusion characteristics on a timely basis.

b. A data base for the assessment of Plant operational impacts.

As such, the operational meteorological monitoring program will be basically a continuation of the preoperational program (refer to Section 6.1.3) with the
2 10-, 60- and 91.5-meter levels of only the 91.5-meter tower.

The equipment used in the operational phase will be the same as that used in the preoperational program. The goals of accuracy and data recovery will be consistent with the recommendations of Regulatory Guide 1.23[1]. However, when the present dew point sensors need replacement, the substituted dew point sensors will have a typical accuracy of ±1°C when the temperature is above freezing.

Parameters to be monitored on the 91.5-meter (300-ft) tower during the operational program are wind speed and direction at the 10-, 60- and 91.5-meter (33-, 197- and 300-ft) levels; air temperature, dew point temperature, and standard deviation of wind direction at the 10-meter (33-ft) level; temperature differential (ΔT) between the 10- and 60-meter (33- and 197-ft) levels, and 10- to 91.5-meter (33- to 300-ft) levels.

To aid in the estimation of offsite, short-term diffusion during batch releases of radioactive material, data on wind speed and direction at the 10-meter (33-ft) level and 10- to 60-meter (33- to 197-ft) ΔT will be available in the Plant control room. During an instrument outage, output from a similar parameter at another level will be substituted.

6.2.3.1.2 Operational Fog and Ice Monitoring Program

2 A two-year operational fog and ice monitoring program will be conducted in the vicinity of the Midland Plant cooling pond after commercial operation of

Unit 2. The objectives of this study are stated in Section 6.2A-3.1.1.2.3 of the Environmental Technical Specifications.

The operational program employs the same procedures used in the preoperational program described in Section 6.1.3.1.8 but with added instrumentation and increased frequency of onsite observer checks. During the operational program, visibility as well as air temperature and relative humidity will be continuously recorded at four locations, one at each corner of the pond. The water temperature of the pond will be measured by a portable immersible dial thermometer at two points in the southwest and northeast corners. The temperature at the discharge point near the northwest corner will be obtained from the Plant operation log. Appropriate wet and dry bulb temperature will
2 be measured with a sling phychrometer at points of interest (refer to Table 6.2A-3-3).

Trained onsite observers will systematically obtain a log steam fog impact observations during the day. In addition to fog data, these observations will include ice on roadways or on vertical surfaces, snow and clouds formed by the pond, and other special phenomena that cannot be recorded by instruments. The onsite observers will also determine whether the detected fog is pond-produced or is due to other causes. The observers' daily schedule will vary to account for the changing length of the day from season to season and prevailing meteorological conditions. In general, the period covered will be from sunrise to sunset, seven days a week.

6.2.3.2 Noise

The operational noise level program provides for a noise level survey to be conducted in the Midland Plant vicinity once the Plant is fully operational.

Results of this survey will be compared to preoperational noise levels to determine the noise impact of Plant operation. A thorough description of the operational program is presented in Section 6.2A-3.1.1.2.4 of the Environmental Technical Specifications.

6.2.4 Land

6.2.4.1 Geology and Soils

6.2.4.1.1 Exploratory

Preoperational exploratory programs are described in Sections 6.1.4.1.1 and 6.1.4.1.2. No further exploratory programs are planned.

6.2.4.1.2 Subsidence

The operational subsidence benchmark program provides data on any subsidence of the ground due to salt mining activities which occurred adjacent to the Plant prior to Plant construction. The preoperational program is described in Section 6.1.4.1.3 and is to be continued on an annual basis for the life of the Plant.

6.2.4.2 Land Use and Demography

The preoperational land use and demographic survey is described in Section 6.1.4.2. An annual operational survey is made to confirm the locations of the nearest milk cow, milk goat, meat animal, vegetable garden (>500-ft^2 in area, 46 m^2), and resident in each 22.5° sector to a distance of 5 miles (8 km) from the Plant as discussed in Section 6.2A-3.2.2c of the Environmental Technical Specifications. Road surveys, county agricultural agents, or other reliable sources are used in the gathering of information for this survey.

6.2.4.3 Ecological Parameters

The operational terrestrial ecology program provides data for the assessment
12 of terrestrial impacts from Plant operations. A thorough description of the
operational program is presented in Section 6.2A-3.1.2.2 of the Environmental
Technical Specifications.

6.2.5 Radiological Monitoring

The operational radiological monitoring program will detect and measure the effects of radiological discharges from the Midland Plant. Results of this program will be comparable to those of the preoperational program described in Section 6.1.5. A thorough description of the operational program is presented in Section 6.2A-3.2 of the Environmental Technical Specifications.

6.2R REFERENCES

1. Directorate of Regulatory Standards, Onsite Meteorological Programs, Regulatory Guide 1.23 (February 1972), US Nuclear Regulatory Commission, Washington, DC.

12

6.3 RELATED ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

6.3.1 Terrestrial Ecological Programs

There are no other known terrestrial ecological monitoring programs that have been, or are being, conducted in the vicinity of the Midland Plant.

6.3.2 Related Aquatic Ecological Programs

The Tittabawassee River in the vicinity of the Midland Plant, downstream to
12 its confluence with the Saginaw River was the focus of several water quality
studies during the 1970s, primarily due to the poor water quality conditions
that existed in the river. Available physical, chemical and biological data
12 for this segment of river are covered in the following reports.

6.3.2.1 Dow Chemical Company Study (Zillich)

An ecological survey of the Saginaw River and its major tributaries with special emphasis on the Tittabawassee River was prepared by J A Zillich[1]. This study was undertaken by The Dow Chemical Company to determine the existing water quality and define the impact of Dow upon the river. The survey studied the interrelationships between the water quality and the organisms in the river and compared them to other rivers in the Saginaw watershed. Information provided in this report was particularly useful in describing the aquatic ecology of the Tittabawassee River (refer to Section 2.2) and the water quality of the river near Midland (refer to Section 2.4.6.1).

6.3.2.2 Michigan Department of Natural Resources Study

A biological survey of the Tittabawassee River, 1971-1972, was prepared by the Michigan Water Resources Commission[2]. This report is inclusive of biological surveys conducted on the Chippewa, Pine and Tittabawassee Rivers above and below the City of Midland. The objective of this survey was to document existing water quality conditions through the measurement and analysis of the biological communities present and then determine areas where water quality improvement would be needed. The biological communities evaluated in this survey included primary producers, macroinvertebrates and fish. This report aided in the assessment of the aquatic ecology of the Tittabawassee River near Midland and provides a basis to compare changes in water quality and associated aquatic communities.

6.3.2.3 Dow Chemical Company Study (Batchelder and Alexander)

A fish survey of the Saginaw River watershed with emphasis on the Tittabawassee River was prepared by The Dow Chemical Company (Batchelder and Alexander[3]). This survey studied fish populations of the Saginaw River Watershed via electrofishing and trap netting. It was undertaken to determine the effects of The Dow Chemical Company discharge on fish populations of the river and demonstrated that a more diverse and balanced fish population existed in the river than had been earlier reported. Results were very relevant to the description of the aquatic ecology (refer to Section 2.2) and estimating the Plant impact on it (refer to Section 5.1.3).

6.3.2.4 Great Lakes Basin Framework Study

The Great Lakes Basin Framework Study[4] is a massive seven-year undertaking, the results of which were published in 27 volumes. The purpose of this Framework Study was to prepare a long-range plan for the conservation, preservation and development of water and related land resources in the US portion of the Great Lakes Basin. This study provides general guidelines for use by governmental and non-governmental decision makers at the local, regional, State and Federal levels in planning and development of priorities for meeting existing and projected demands for conservation, development and use of the environment. This type of information was also helpful in preparing this Environmental Report since planning Subarea 3.2 of the Framework Study coincided closely with the Midland Study area. For this area, the Framework Study provided a comprehensive inventory of water and related land resources, identified environmental problems present and projected resource demand and supply including water withdrawals, and instream and water surface uses.

6.3.2.5 Great Lakes Resource Management Program

An Evaluation of Existing and Historical Conditions of Saginaw Bay[5] was prepared by P L Freedman and discusses the geomorphology, hydrology, contaminant sources, physical and chemical parameters and biological considerations of the Bay. Freedman identified the deteriorated water quality conditions of Saginaw Bay and factors responsible for those conditions.

6.3.2.6 International Joint Commission Assessment

A comprehensive ecological survey of the waters of Lake Huron and Lake Superior was prepared by the International Joint Commission[5a]. The purpose
12 of the Upper Great Lakes Reference study was to assess the impact of economic activity on Lake Huron and Lake Superior and provide information for future water quality management. The Saginaw Bay watershed was comprehensively addressed as part of this assessment.

6.3.3 Meteorological Programs

The National Weather Service conducts meteorological monitoring programs in the Plant vicinity as described in Section 2.3. In addition to the National Weather Service programs, limited meteorological monitoring is also conducted by The Dow Chemical Company and the Chippewa Nature Center. However, the data collected by Dow Chemical and the Chippewa Nature Center are not collected per NRC standards and are not used in this report.

The Dow Chemical Company installed instruments for determining wind speed and direction approximately 20 years prior to 1980, and these data were recorded and retained for an unknown period of time. In 1980, these instruments were
12 relocated and are now installed at a height of approximately 50 feet on Dow's 1100 building which is located about 3,300 feet north of the Plant Meteorological Tower. The signals are sent to a mini-computer which keeps a 15-minute running average of wind speed and direction for atmospheric dispersion calculations by Dow. The data are no longer recorded. Since 1975, Dow Chemical has utilized meteorological data from Consumers Power Company's Meteorological Tower for its Supplementary Control System (fuel switching program for air pollution control).

12 As part of its education program since 1980, the Chippewa Nature Center has collected wind speed, wind direction and air temperature data at a height of 30 feet on a tower. Precipitation and solar radiation data have also been collected from instruments atop the interpretative building. The nature center is about 3.5 miles northwest of the Plant Meteorological Tower.

6.3.4 Hydrological Program

6.3.4.1 The Dow Chemical Company

12 In addition to the water quality information presented in Section 2.4.6.1, The Dow Chemical Company, Midland, Michigan, conducts a water quality monitoring program required by its National Pollutant Discharge Elimination System Permit. This program consists of monitoring the following parameters in the Tittabawassee River:

12 At Freeland, Michigan (downstream of the discharge mixing zone)

Parameter	Frequency	Sample Type
Flow	Daily	
Temperature	Continuous	Daily Maximum and Average
Total Dissolved Solids	Weekly	24-Hour Composite
Dissolved Oxygen	Continuous	Daily Minimum and Average
Total Suspended Solids	Twice Weekly	24-Hour Composite
BOD_5	Weekly	Grab
Chlorides	Daily	24-Hour Composite
Conductivity	Continuous	Daily Maximum and Average
12 Total Oxygen Demand	Continuous	Daily Maximum and Average

12 At the Dow Dam (upstream of the discharge point)

Parameter	Frequency	Sample Type
Flow	Daily	
Temperature	Twice Weekly	Instantaneous
Total Dissolved Solids	Twice Weekly	24-Hour Composite
Total Suspended Solids	Twice Weekly	24-Hour Composite
BOD_5	Twice Weekly	Grab
Conductivity	Continuous	Daily Minimum, Maximum, and Average
Total Oxygen Demand	Continuous	Daily Minimum, Maximum, and Average

6.3.4.2 US Geological Survey

A continuous flow monitoring station in the Tittabawassee River at Midland is maintained by the United States Geological Survey (USGS). Data from this station have provided the base for river flow characteristics and withdrawal limitations. The Midland Plant will continue to obtain data from this USGS station.

The Water Resources Division of the USGS collects and analyzes data from a number of gaging stations in Michigan with the assistance of various divisions of the Michigan State Department of Natural Resources and numerous other State and local organizations. At or near some gaging stations, water quality data also are collected as well as water temperature, suspended-sediment concentration, and particle size distribution of suspended sediment and bed material. Water quality data for the Tittabawassee River in and around the City of Midland were gathered between 1969 and 1974 at several stations. The most extensive data were collected for Smith's Crossing, approximately one

mile downstream of the Midland Plant. Current monitoring programs indicate that the data gathered from these stations are no longer applicable.

6.3.4.3 East Central Michigan Planning and Development Region

The East Central Michigan Planning and Development Region conducts research and planning programs relative to water pollution and its environmental effects. This agency has issued a report on current water quality conditions as part of the Region VII Areawide Waste Treatment Management Study[6] performed by Chester Engineers. The Tittabawassee River water quality data presented in this study are derived from the USGS water quality data for Smith's Crossing. Additionally this report discusses the geomorphology, hydrology, contaminant sources, physical and chemical parameters and biological considerations of the various water resources in the planning region. The report contains good descriptions and summaries of previous studies on the Tittabawassee River, its tributaries, the Saginaw River and Saginaw Bay. Several aspects of this report, especially concerning groundwater and surface water uses, were relevant to the Midland Plant for determining its impact on the water resources of the area.

Since this agency conducts continuing programs, future reports may include relevant data for the Tittabawassee River.

6.3.4.4 STORET Data

The Water Resources Commission of the Michigan Department of Natural Resources[7] conducts yearly and monthly surveys at several locations within the State of Michigan. Parameters are analyzed according to Standard Methods[8]. The results of those surveys are reported in a Water Quality

Status Inventory by county and by stream. The results are also stored in a computer file system known as STORET for later retrieval. The STORET data retrieval system enables one to readily obtain a wide array of data from particular locations for a specific period of time. STORET data for the Tittabawassee River in the Midland area have been used in various parts of this Environmental Report which involve river water chemistry.

6.3.4.5 Water Quality Management Plan for Lower Lake Huron Basin

The Lower Huron River Water Quality Management Plan[9] was one of a series of plans that were prepared by the State of Michigan to comply with the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) and subsequent regulations and guidelines. The purpose of the basin plan was to provide information the State would need to make centralized coordinated water quality management decisions. This basin plan is a management document that identified the basin's water quality problems. The basin study area closely overlaps the 50-mile radius of the Midland Plant and was, therefore, very helpful in describing water quality conditions and uses of water in that area, particularly along the Tittabawassee and Saginaw Rivers.

6.3.4.6 Other Programs

The multi-disciplinary Great Lakes Basin Framework Study and Great Lakes Resources Management Program are discussed in Sections 6.3.2.4 and 6.3.2.5, respectively.

6.3.5 Geological Programs

There are no other known geological monitoring programs conducted in the area of the Midland Plant.

6.3.6 Archeological Programs

Excavations of the Sumac Bluff and Naugle Sites in Midland County were performed in 1971, 1972 and 1973, respectively[10,11]. The Sumac Bluff Site is within the Chippewa Nature Center on the eastern bank of the Chippewa River to the north of the mouth of the Pine River. The Naugle Site is also within the Chippewa Nature Center located just west of the confluence of the Pine and Chippewa Rivers. Both sites are about 3-1/2 miles (5-6 km) to the northwest of the Midland Plant.

Brief investigations by several avocational archeologists have been conducted in the past of five sites on the Midland Plant site. These sites are described as part of the archeological background in the report, Archeological and Historical Investigations of the Floodplain Area, Midland Plant Site,
5 Midland, Michigan.

The archeological investigations in 1971 of the Plant site by the Saginaw Valley Chapter of the Michigan Archeological Society are briefly described in Section 2.6.1. These investigations are also part of the archeological background of the report noted above.

6.3.7 Noise Programs

At the present time, the only other party conducting any sound level surveys in the vicinity of the Midland Plant is The Dow Chemical Company. Using field

measurement techniques, these surveys are done occasionally around the perimeter of The Dow Chemical complex by the environmental quality control group and are intended for informational purposes only. Past surveys by Dow Chemical did not include the southern property along the Tittabawassee River. Therefore, no data have been obtained for the areas immediately adjacent to the Midland Plant. The nearest data point is on Saginaw Road approximately 4,000 feet (1,219 m) east of the Midland Plant. This point and others are
11 within the area that Consumers Power Company personnel will survey prior to commercial operation of the Midland Plant. All survey data will be made available to both companies and correlation will be done upon completion of
11 the preoperational ambient survey which is described in detail in Section 6.1.3.1.

6.3.8 Radiological Programs

There are no public agencies, currently known to the Applicant, conducting any radiological environmental monitoring programs in the vicinity of the Plant. The Michigan Department of Public Health does plan to conduct an environmental monitoring program in the vicinity of the Plant similar to those currently conducted by that agency at operating reactors within the State[12,13]. However, no definite date has been established for initiation of this program.

6.3R REFERENCES

1. J A Zillich, Ecological Survey of the Saginaw River and Its Major Tributaries With Special Emphasis on the Tittabawassee River (1973), Dow Chemical Company.

2. Water Resources Commission (compiler), Biological Survey of the Tittabawassee River (1971-1972) (1972), Bureau of Water Management, Michigan Department of Natural Resources.

3. T L Batchelder and H C Alexander, Fish Survey of the Saginaw River Watershed With Emphasis on the Tittabawassee River (1974), Waste Control Department, Midland Division, Dow Chemical Company.

4. Great Lakes Basin Commission (compiler), Great Lakes Basin Framework Study, Appendixes 2, 3, 4, 6, 7, 8, C9, R9, 15 and 21 (1975), Great Lakes Basin Commission.

5. P L Freedman, Saginaw Bay: An Evaluation of Existing and Historical Conditions, Report No: EPA - 905/9-74-003 (1974), University of Michigan, Great Lakes Resource Management Program, US Environmental Protection Agency.

12 5a. International Joint Commission, The Waters of Lake Huron and Lake Superior, Vol II, Parts A & B (1977).

6. The Chester Engineers, Assessment of Current Water Quality Conditions and Factors Responsible for Those Conditions (July 1976), East Central Michigan Planning and Development Region.

7. Water Resources Commission (compiler), STORET Data (1974), Michigan Department of Natural Resources.

8. American Public Health Association, Standard Methods, 13th Edition (1971), American Public Health Association.

9. Michigan Water Resources Commission (compiler), Water Quality Management Plan for Lower Lake Huron Basin (1974), Water Development Services Division, Michigan Department of Natural Resources.

10. D Ozker, "Sumac Bluff (20MD25), A Site on the Chippewa River in Midland," Michigan Archaeologist, Volume 22 (1976), pp 283-313.

11. D Ozker, "The Naugle Site (20MD30) Midland County, Michigan: Early Late Woodland and Late Archaic Components on a Pine River Site," Michigan Archaeologist, Volume 22 (1976), pp 315-355.

12. Telephone Conversation From M G Dickson, Consumers Power Company, to J E Hennigan, Division of Radiological Health, Michigan Department of Public Health, June 21, 1977.

13. Division of Radiological Health, Nuclear Power and Public Health in Michigan (May 1, 1976), Michigan Department of Public Health.

6.4 PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING DATA

11 A limited amount of radiological data are available on raw Lake Huron water
(Whitestone Point) and Midland municipal water. Samples are composites of
daily (Monday through Friday) grab samples. Analyses were performed by three
independent laboratories over a one-year period. Gross beta and tritium
11 results are provided in Table 6.4-1. Monthly composites of the weekly samples
were analyzed for gamma emitting isotopes. Within the detection limits
(approximately 10 pCi/ℓ) no gamma activity was observed in any of the samples.

The preoperational environmental radiological monitoring program as described
11 in Section 6.1.5 started in November 1978. The schedule for all phases of the
12 preoperational program is presented in Table 6.1-8. The first two full
calendar years of data are presented in Table 6.4-2.

TABLE 6.4-1

SUMMARY OF LABORATORY RESULTS

GROSS BETA ANALYSIS

Laboratory	Sample Location	Collection Period	Results (pCi/1) No of Samples	Max	Min	Mean	Error (2 σ)
A	Treated City Water	7/76 - 3/77	31	7	1	2.7	2.8
	Raw Lake Water	7/76 - 3/77	31	9	1	3.0	3.5
B	Treated City Water	7/76 - 4/77	37	2.4	0.3	1.7	1.1
	Raw Lake Water	7/76 - 4/77	38	3.9	1.0	1.7	0.6
C	Treated City Water	2/77 - 6/77	24	2.3	1.1	1.7	0.5
	Raw Lake Water	2/77 - 6/77	17	2.7	1.3	2.1	0.7

TRITIUM ANALYSIS

	Laboratory	Sample Location	Collection Period	Results (pCi/1) No of Samples	Max	Min	Mean	Error (2 σ)
11	A	Treated City Water	7/76 - 3/77	31	700	110	393	303
		Raw Lake Water	7/76 - 3/77	31	700	170	410	284
	B	Treated City Water	7/76 - 1/77	10	369	184	340	130
		Raw Lake Water	7/76 - 1/77	10	424	232	310	110
	C	Treated City Water	2/77 - 7/77	23	360	<150	250	110
		Raw Lake Water	2/77 - 7/77	23	360	<150	270	98

(a) Mean of all samples with samples indicating less than detectable activity presumed at detection limit.

TABLE 6.4-2

MIDLAND PLANT - ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY
January 1, 1979 Through December 31, 1980

Medium or Pathway Samples (Unit of Measurement)	Analysis and Total Number of Analyses Performed		Lower Limit of Detection[a]	All Indicator Locations (Mean)[b] (Range)[b]	Locations With Highest Annual Mean (Name) (Distance and Direction)	Locations With Highest Annual Mean (Mean)[b] (Range)[b]	All Control Locations (Mean)[b] (Range)[b]
Surface Water (pCi/ℓ)	Gross Beta	102	1.0	4.6 (80/84) (2.0 - 13.0)	River - Plant Discharge 1100 Feet NE	5.8 (13/13) (3.0 - 11.0)	4.4 (17/18) (1.0 - 12.0)
	Gross Alpha	83	1.0[c]	2.3 (14/69) (1.0 - 3.0)	River - Freeland Road Bridge 11 Miles SE #1 Discharge 650 Feet SSE	3.0 (2/14) (3.0 - 3.0) 3.0 (1/1) (3.0 - 3.0)	2.0 (4/14) (1.0 - 3.0)
	Tritium (Qtr)[d]	36	100.0	238.9 (26/30) (100.0 - 690.0)	Cooling Pond - CW Intake 650 Feet SE	363.3 (6/6) (100.0 - 690.0)	170.0 (5/6) (90.0 - 220.0)
	I-131[d]	90	1.0	<LLD	-	-	<LLD
	Fe-59; Zn-65[d]	90	30.0	<LLD	-	-	<LLD
	Mn-54; Co-58-60[d]	90	15.0	<LLD	-	-	<LLD
	Zr-Nb-95; Ba-La-140 Cs-134-137[d]	90	10.0	<LLD	-	-	<LLD
Ground Water (pCi/ℓ)	Gross Beta	163	1.0	17.4 (147/163) (2.0 - 170.0)	East Pond Dike/Wells 6, 7 & 8 4950 Feet SE	30.1 (38/42) (2.0 - 170.0)	None
	Gross Alpha	157	1.0	2.5 (46/157) (1.0 - 8.0)	West Pond Dike/Wells 16, 17 & 18 4600 Feet SW	2.3 (19/40) (1.0 - 8.0)	None
	Tritium[d]	149	100.0	305.3 (72/149) (90.0 - 790.0)	South Pond Dike/Wells 11, 12 & 13 6250 Feet S	356.0 (10/36) (100.0 - 790.0)	None
	I-131[d]	163	1.0	<LLD	-	-	None
	Fe-59; Zn-65[d]	163	30.0	<LLD	-	-	None
	Mn-54; Co-58-60[d]	163	15.0	<LLD	-	-	None
	Zr-Nb-95; Ba-La-140 Cs-134-137[d]	163	10.0	<LLD	-	-	None
Gamma Dose[e] (mR/Month)	TLD (Monthly)[f]	257	1.0	8.3 (206/206) (3.8 - 30.2)	Pole - SE Dow Fence 2400 Feet ENE	9.8 (17/17) (4.9 - 30.2)	7.8 (34/34) (3.7 - 25.1)
12 (mR/Quarter)	TLD (Quarterly)[f]	119	1.0	14.7 (95/95) (10.3 - 24.6)	Pole - S of Dow 2250 Feet NNW	17.1 (8/8) (11.1 - 24.6)	13.6 (16/16) (11.0 - 19.6)
Crops (pCi/g Wet)	Gross Beta	88	1.0	3.1 (53/67) (1.0 - 9.2)	G-3 8750 Feet NE	4.5 (6/9) (1.0 - 9.2)	2.9 (21/2[illegible] (0.9 - 6.[illegible]
	I-131[d]	92	0.06[g]	<LLD	-	-	<LLD
	Cs-134[d]	92	0.08	<LLD	-	-	<LLD
	Cs-137[d]	92	0.08	0.1 (2/67) (0.8 - 0.11)	G-7 11766 Feet NNE	0.11 (1/8) (0.11 - 0.11)	<LLD
	Sr-89[d]	92	0.025	<LLD	-	-	<LLD
	Sr-90	92	0.005	0.08 (64/71) (0.005 - 0.31)	G-6 11700 Feet ENE	0.13 (7/8) (0.02 - 0.31)	0.06 (20/21) (0.006 - 0.46)
Sediment (pCi/g Dry)	Gross Beta	17	1.0	2.8 (4/14) (1.0 - 5.0)	Cooling Pond - CW Intake 650 Feet SE	5.0 (1/1) (5.0 - 5.0)	2.0 (1/3) (2.0 - 2.0)
	Cs-134-137[d]	17	0.15	<LLD	-	-	<LLD
	Sr-89	17	0.025	<LLD	-	-	<LLD
	Sr-90	17	0.005	0.08 (4/17) (0.02 - 0.2)	Cooling Pond - CW Intake 650 Feet SE	0.2 (1/1) (0.2 - 0.2)	<LLD
Fish (pCi/g Wet)	Gross Beta	24	1.0	2.3 (14/16) (1.0 - 4.3)	Cooling Pond - CW Intake 650 Feet SE	3.5 (1/1) (3.5 - 3.5)	1.9 (7/8) (1.0 - 3.4)
	Fe-59; Zn-65[d]	24	0.26	<LLD	-	-	<LLD
	Mn-54; Cs-134[d]	24	0.13	<LLD	-	-	<LLD
	Co-58-60 Cs-137[d]	24	0.13	0.16 (4/20) (0.09 - 0.19)	River - Railroad Bridge 3950 Feet ESE River - Plant Discharge 1100 Feet NE	0.19 (1/6) (0.19 - 0.19) 0.19 (1/4) (0.19 - 0.19)	0.09 (2/8) (0.06 - 0.12)
	Sr-89	24	0.025	<LLD	-	-	<LLD
	Sr-90	24	0.005	0.01 (2/16) (0.006 - 0.01)	River - Railroad Bridge 3950 Feet ESE	0.001 (2/6) (0.006 - 0.01)	0.01 (3/8) (0.006 - 0.013)

(a)Nominal lower limit of detection (LLD) as defined in HASL-300, Pages D-08-01, 02 and 03[1].

(b)Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses.

(c)A few samples had high amounts of total solids or low chemical yield which resulted in LLDs between 1.0 and 4.0 pCi/ℓ.

(d)Proposed Technical Specifications requirements.

(e)Includes transit dose which averages approximately 6.8 mR per round trip.

(f)Additional Data: Community TLD (Monthly) - mean and range of 7.4 (17/17) and (3.7 - 19.9);
Community TLD (Quarterly) - mean and range of 12.4 (8/8) and (10.0 - 16.9).

(g)For 1.0 g samples. A few vegetation samples were smaller and resulted in LLDs between 0.06 and 0.09 pCi/g.

6.4R REFERENCES

12 1. Health and Safety Laboratory; US Atomic Energy Commission, HASL-300 Procedures Manual.

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8 ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

8.1 BENEFITS FROM THE FACILITY

8.1.1 Expected Annual Average Generation

11 The Midland Station is designed as a dual-purpose plant to provide electrical energy to the customers of Consumers Power and process steam to The Dow Chemical Company. The electrical energy output will vary from 1,263 MW (net) at design up to 1,344 MW (net) depending on the process steam outflow to Dow. As such, the estimated net average annual generation will range from 7.7 billion to 8.2 billion kilowatthours, based on a 70 percent capacity factor.

8.1.2 Expected Use of Generated Electricity

11 Because the output of Midland Units 1 and 2 is transmitted by the total power network of Consumers Power's transmission and distribution system, it must be assumed that the sales to a particular customer class are in the same proportion as that customer class proportion of total system usage. The sales forecast for each customer class is listed for the period 1984 through 1988
12 and for 1995 in Table 8.1-1.

11 The average electric customer rate is estimated to be 7.5 cents per kilowatthour which includes generation, transmission and distribution costs for all of Consumers Power customers in 1984. Over Midland's plant life, electric customers' rates are estimated to increase at an average annual rate of 8.24 percent per year. The levelized annual revenues received from Midland's generation based on a design net rating of 12[illegible] MW at a 70 percent capacity factor are estimated to be $1.3 billion per year in 1984 dollars. The present

11 worth revenues in 1984 dollars are estimated to be $10.8 billion over the 34-year life of the plant.

8.1.3 Process Steam Sales

11 Process steam sales to The Dow Chemical Company will generate revenues for the
12 35-year period of the current contract. The Midland Plant Units 1 and 2 will
3 supply from 1.4 to 4.05 million pounds per hour of process steam which equals
12 14,121 to 40,962 billion Btus per year at a 100% capacity factor. Based on the expected hours of process steam availability and 4.05 million pounds per hour, 38.839 billion Btus per year will be converted to process steam for sale to Dow.

3 The steam sales provisions of the 1978 Dow-Consumers general agreement are proprietary information.

8.1.4 Income and Property Taxes

7 Income and property taxes expected to flow to Federal, State, and local
12 governments because of the Midland Plant are estimated to be $122 million per
7 year. The present worth of this payment stream over the 34-year economic life
12 is $869 million. The effect on taxes of decommissioning and restoration are not reflected in these data (all costs in 1984 dollars).

8.1.5 Direct Socioeconomic Benefits

The operation of the Midland Plant provides certain direct and indirect economic benefits to the Midland region. A portion of the direct benefits
12 originates with the operating and testing personnel employed at the Plant. Present plans call for about 595 personnel to be employed at the Midland

12 Plant. The presentation of the direct benefits associated with the site management personnel is based on a study[5] prepared for the US Chamber of Commerce. This study measures the impact of 100 manufacturing and nonmanufacturing employees entering a region. Using this information, the following effects are projected for the Midland region:

1,460 more people

12 410 more families

480 more schoolchildren

11 and the following resultant benefits (1984 dollars) are projected for the Midland region:

$14,310,000 more annual personal income[a]

12 $6,482,000 more annual retail sales

$7,894,000 more annual bank deposits

The increased number of families will not create any major lasting impact on housing or real estate values in the area. The additional schoolchildren should be easily absorbed within the region without the need for new facilities. The increased personal income will help to provide indirect benefits within the region.

11 ---

(a) Total annual salary for Midland Plant staff in 1984 is estimated to be
12 approximately $17,000,000 in 1984 dollars. The retail sales and bank
11 deposits may be correspondingly higher.

4 The projected annual employment schedule of the Midland Plant staff for
commercial operation is:

2

End of Year	Total Employment
1981	379
1982	507
12 1983-to end of 40-year Plant life	595

It is estimated that approximately 85% or 506 of the projected 595 personnel
11 will be newcomers to the Midland area. Of these newcomers, it is projected
12 that approximately 70% or 354 will establish residence within the City of
11 Midland or in the immediate surrounding townships. The remaining
12 152 newcomers are expected to be randomly located in outlying townships at
2 distances up to approximately 40 miles.

4 Locally contracted services and merchandise (ie, consumables) will result in
12 annual expenditures of more than $6 million (in 1984 dollars) in the three
4 counties of Midland, Saginaw and Bay. This is exclusive of all wages for
12 Midland Plant personnel.

8.1.6 Indirect Socioeconomic Benefits

Indirect benefits are derived as a consequence of the Plant employees spending their earnings. Through their consumption of housing services, retail goods and the like, the direct employees will create the demand for secondary jobs.

To assess the indirect employment benefits, a regional employment multiplier may be implemented. A multiplier of 1 would indicate no secondary employment effects and usually applies to a sparsely populated rural area. Values of 3.0

or more apply to heavily urbanized environs(6). Although a regional multiplier for Midland is not known, a value of 2 would be a conservative 12 estimate. This would imply that a minimum of 510 service jobs would result from the operation of the Plant. Many of these jobs would be filled by local personnel which would favorably contribute to the Midland social and economic environment.

8.1.7 Environmental Benefits

The environmental studies described in Chapter 6 will result in increased knowledge of the environment in the following areas:

a. Monitoring of the ecological and water quality rehabilitation of the Tittabawassee River;

7

12 b. Effects of attracting avifauna to an artificial water body which potentially remains ice-free the year round during Plant operation;

7 c. Cooling pond induced fog occurrence;

d. Icing effects on trees.

The ice-free pond may attract a resident population of waterfowl, shore birds and marsh birds. Any increase in the number of these birds would improve the natural and aesthetic amenities of this generally industrialized area.

12

The river intake structure, riprap along the river shore, and river channelization near the intake structure will provide improved shelter and feeding habitat for fishes in the vicinity.

In addition, the atmospheric emissions from the existing fossil-fueled units of Dow Chemical Company will be greatly reduced and eventually cease.

TABLE 8.1-1

SALES FORECAST

	Class	Percent of Sales by Class by Year 1984	1985	1986	1987	1988	1995
	Residential	30.9	30.5	30.6	30.5	30.5	30.8
	Commercial	24.1	24.1	24.4	24.7	24.9	26.3
12	Industrial	41.0	41.5	41.1	40.9	40.8	39.4
	Streetlighting	0.6	0.5	0.5	0.5	0.5	0.3
	Other	3.5	3.4	3.4	3.4	3.3	3.1

This breakdown is based on the following projection of long-term growth rates by class of service:

11

		Percent by Year
	Residential	2.8
	Commercial	3.5
12	Industrial	2.5
	Streetlighting	-1.5
	Other	1.8
	Total	2.8

8.2 COSTS ASSOCIATED WITH THE FACILITY

All of the costs listed in this section are reported in 1984 dollars in accordance with the following construction completion schedule:

		Unit 1	Unit 2
11	Construction Completion[a]	8/83	3/83
	Fuel Load	12/83	7/83
	Commercial Operation	7/84	12/83

The present worth of each of the costs in 1984 is calculated using a discount
12 rate of 13.875 percent and a 34-year economic life.

Estimated levelized annual costs of electric energy production from the Midland Plant are shown in Table 8.2-1.

8.2.1 Capital Costs of Facility Construction

The capital cost of constructing Midland Units 1 and 2, including the costs of the approximately 1,235-acre site, is estimated to be $3.1 billion as shown in Table 8.2-2. This amount includes anticipated escalation in labor and mate-
11 rial costs over the period of construction as well as interest on investment over the same period.

(a) Where construction completion is defined as the last system turnover to Consumers Power Company.

8.2.2 Capital Costs of Transmission Facilities

The cost of constructing the transmission lines and substation facilities
necessary to connect the Midland Units 1 and 2 into the Michigan Bulk Power
11 system is estimated to be $19.5 million. This amount includes anticipated
escalation in labor and material over the period of construction as well as
interest on investment over the same period.

8.2.3 Fuel Costs

Fuel costs associated with the production of electrical and steam energy over
11 the 34-year economic life of the Plant will not vary with the process steam
outflow to The Dow Chemical Company. Based on two power only units, the
12 levelized annual cost is currently estimated to be approximately 17.8 mills
per kilowatthour. The present worth in 1984 dollars of cost of fuel
11 associated with the production of electrical energy is estimated to be
12 $870.1 million.

8.2.4 Operating and Maintenance Costs

7 The uniform annual equivalent operating and maintenance costs, including
annual license fees but excluding nuclear insurance, are estimated to be
$161.3 million, equalling a present worth of $1,148.6 million in 1984 dollars.
12 Nuclear insurance is estimated to be $8.6 million in 1984, equalling a present
worth of $182.8 million.

8.2.5 Costs of Decommissioning and Dismantling

11 Decommissioning and dismantling the main power structure, which is an NRC
requirement, is estimated to cost $235.0 million in 1984 dollars. Of this

total, removal of the pond and intake structures and relandscaping of the
12 Plant site, which are local requirements, are estimated to cost $41.9 million.

3 Section 5.8 is a discussion and cost breakdown for decommissioning and
dismantling the Midland Plant.

8.2.6 Cost of Income and Property Taxes

7 Income and property taxes expected to flow to Federal, State and local
governments because of the Midland Plant are estimated to be $122 million per
12 year. The present worth of this payment stream is $869 million. The effect
11 on taxes of decommissioning and restoration are not reflected in these data.

8.2.7 Socioeconomic Costs

Additional municipal services would be required to support the Plant operating personnel who live in the area; however, the property taxes incurred by the Midland Plant will more than offset the increase in service costs.

11 Public service impacts attributable to the immigration of newcomers due to
operation of the Plant are expected to be minimal. For example, the 410
12 additional schoolchildren (who are newcomers) would represent approximately 4%
of the total projected Midland school 1982-83 enrollment of 9,330 if all were
to be enrolled in Midland schools.

11 Regarding traffic services, the vehicles introduced by Midland Plant staff
12 personnel who are newcomers would represent approximately 1% of all registered
11 vehicles in the Midland area. This figure is based on an average of 1.7
12 vehicles per staff member (860 vehicles) and the 1979-80 registration of
11 64,000 vehicles total.

8.2.8 Environmental Costs

Only minor environmental costs are associated with the operation of the Midland Plant:

a. Preemption of 1,235 (500 ha) acres of land from other uses during the life of the Plant;

b. An increase in local fogging and icing;

c. Entrainment of planktonic organisms (phytoplankton, zooplankton,
12 ichthyoplankton, and invertebrates) during the initial filling of the
cooling pond and intermittent makeup pumping;

d. Impingement losses of some resident and migrant fish species during
12 the initial filling of the cooling pond and intermittent makeup
pumping;

e. Temperatures elevated above normal river temperature fluctuations during blowdown.

f. Possible increased bird mortality rates due to increased avifauna
12 populations attracted to the cooling pond.

11 TABLE 8.2-1

ESTIMATED GENERATING COSTS FOR THE MIDLAND PLANT

(Levelized Annual Mills/kWh Equated to 1984 Dollars)

11	Fixed Charges	
12	Cost of Money	48.1
	Depreciation[a]	0.6
	Taxes[a]	13.7
11	Nuclear Fuel Cycle Costs	
12	Fuel Depletion Charge	11.0
	Fabrication Depletion Charge	2.7
	Fuel Carrying Charge	2.6
	Spent Fuel Storage Charge	1.5
11	Cost of Operation and Maintenance	
12	Fixed Component	17.5
	Variable Component	0.0
11	Cost of Insurance	
12	Property Insurance	2.5
	Liability Insurance	0.3
	Total	100.5

11 (a)The effect of decommissioning and restoration are not reflected in these data.

11 TABLE 8.2-2

COST INFORMATION FOR NUCLEAR POWER GENERATION METHOD

1. Interest During Construction		8.5%/Year, Jan-Sept 1980
12		9.[illegible]3%/Year, Oct-Dec 1980
		10%/Year, 1981 and 1982
		10.5%/Year, 1983 and Beyond
2. Length of Construction Workweek		40 Hours/Week
3. Estimated Site Labor Requirement		20.4 Manhour/kWe
4. Escalation Rates	Site Labor	10.0%/Year in 80-81 and 8.0%/Year Thereafter
	Materials	10.0%/Year in 80-81 and 8.0%/Year Thereafter
11	Composite	10.0%/Year in 80-81 and 8.0%/Year Thereafter

5. Power Station Cost ($1,000)

Direct Costs	Unit 1	Unit 2
a. Land and Landrights	$ 0*	$ 5,883
b. Structures and Site Facilities	143,698	206,586
c. Reactor Plant Equipment	140,955	231,296
d. Turbine Plant Equipment, Not Including Heat Rejection	61,671	75,380
e. Heat Rejection System	8,972	12,538
f. Electric Plant Equipment	42,659	94,444
g. Miscellaneous Equipment	33,075	11,198
h. Spare Parts Allowance	0*	4,000
i. Contingency Allowance	0*	85,000
12		
Subtotal	$431,030	$ 726,325
Indirect Costs		
11 a. Construction Facilities, Equipment and Services	0*	369,127
b. Engineering and Construction Management Services	0*	272,401
12 c. Other Costs	0*	411,117
d. Interest During Construction (@ Rates Above)	0*	890,000
Escalation		
Escalation During Construction	Included Above	
11 **Total Cost**		
Total Station Costs, @ Start of Commercial Operation	$431,030	$2,668,970

*Included With Unit 2

TABLE 11-1

SUMMARY OF COSTS AND BENEFITS

Rev.	Item	Steam Outflow @ 4.05×10^6 Lb/Hr
	Direct Benefits (Annual)	
	Energy Generated (at 70% Capacity	
11	Factor) Kilowatthours	7.7×10^9
	Capacity, Kilowatts	$1,263 \times 10^3$
	Proportional Distribution of Electrical Energy (Expected Annual Delivery in Kilowatthours 1984)	
12	Industrial	3.1×10^9
11	Commercial	1.8×10^9
12	Residential	2.4×10^9
11	Streetlighting	0.1×10^9
12	Other	0.3×10^9
	Energy to Steam Sold From the Facility, Btu x 10^6	$38,839 \times 10^3$
	Expected Average Annual Delivery of Other Beneficial Products	0
11	Revenues From Delivered Benefits, $/Yr	
	Electrical Energy Sold	1.3×10^9
	Steam Sold	Proprietary
	Other Products	0
	Indirect Benefits (Annual)	
	Taxes, $/Year	
	Local	62.0×10^6
12	State	2.7×10^6
	Federal	57.4×10^6
11	**Direct Benefits (Present Worth in Millions of Dollars)**	
	Revenues	
12	Electrical Energy Sold	9,294
11	Steam Sold (35-Year Period)	Proprietary
	Indirect Benefits (Present Worth in Millions of Dollars)	
	Taxes	
	Local	408.7
	State	19.2
12	Federal	441.5
	Total Direct and Indirect Benefits	10,163.4
	Primary Internal Costs (Present Worth in Millions of Dollars)	
11	Capital Investment	3,100.0
	Transmission Facilities	19.5
	Fuel	870.1
12	Operating, Maintenance and Insurance	1,331.4
11	Decommissioning and Dismantling	235.0
	Income and Property Taxes	869.4
12	Total	6425.4

11 NOTE: All dollars are in 1984 dollars.

TABLE 11-2

SUMMARY

11 SOCIOECONOMIC AND ENVIRONMENTAL BENEFITS AND COSTS OF MIDLAND PLANT OPERATION

	Benefits	
12	Socioeconomic[a]	
11	Consumables	$ 6,000,000
	Annual Personal Income	14,310,000[a]
12	Annual Retail Sales	6,482,000
	Bank Deposits	7,894,000
	Environmental	
11	Knowledge of the Environment as a Result of Research and Monitoring	Increase
12	Avifauna Populations	Possible Increase
	River Sport Fishing	Possible Improvement
	Fish Shelter and Feeding Habitat	Increase
	Atmospheric Emissions From Dow Fossil-Fueled Units	Reduction
	Costs	
	Socioeconomic	
11	Municipal Services Required	Increase[b]
	Environmental	
	Land Use	Loss of 1,235 Acres From Other Uses
	Fogging and Icing	Increase
	Plankton	Small Entrainment Loss During Makeup Periods
	Resident and Migrant Fish	Some Impingement Loss During Makeup Periods
	River Temperatures	Increase Above Ambient During Blowdown Periods
	Avifauna Populations	Possible Increased Mortality Rates
12		

(a)All costs are annual costs in 1984 dollars.

(b)Total annual salary for Midland Plant staff in 1984 is estimated to be approximately $17,000,000 in 1984 dollars. The retail sales and bank
11 deposits may be correspondingly higher.

12 (c)Property taxes incurred by the Midland Plant will more than offset the
11 increase in service costs.

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NRC QUESTIONS AND RESPONSES

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AQUATIC ECOLOGY

QUESTION 1

As the majority of fish, especially eggs and larvae, will be located along the banks rather than the mid-channel area, is it not likely that greater than 5% of the fish would be influenced by plant operations? What will be the estimated maximum percentage of fish so influenced?

RESPONSE

During 19[illegible]c), Lawler, Matusky and Skelly Engineers (LMS) conducted an aquatic assessment to investigate the distribution of juvenile fish, fish eggs and larvae. Compared to 1977 and 1978 surveys by Central Michigan University[b,c], the LMS assessment utilized an increased sampling frequency and the sampling methods were changed from passive larval seines and stationary drift nets to larval seines and actively towed oblique and surface nets.

12

(a) Lawler, Matusky and Skelly Engineers, Aquatic Assessment of the Tittabawassee River in the Vicinity of Midland, Michigan, (May 1980).

(b) D E Wujek, et al, Preliminary Water Quality Survey of the Tittabawassee River, Midland, Michigan, (February 1978), Central Michigan University.

(c) H L Lenon, et al, Survey and Evaluation of the Water Quality, Tittabawassee River, near Midland, Michigan, 1978-1979, (April 1979), Central Michigan University.

The 1979 data collection did not indicate an unusually large abundance of juvenile fishes, fish eggs and larvae near the shorelines of the Tittabawassee River. Instead, the study indicated few significant differences between shoreline and mid-channel stations. The LMS data indicate gear avoidance during 1977 and 1978 surveys was likely responsible for the biased shoreline abundance information.

12 Plant operations will not require the use of makeup waters containing disproportionate numbers of fishes, since current sampling results indicate that fish eggs and larvae in the Tittabawassee River near the Midland Plant are not uniformly distributed.

The maximum percentage of fishes influenced by plant operation has not been determined. A predictive assessment is anticipated by October 1981. Currently, makeup restrictions and fishery data indicate plant operation will have a negligible influence on the fishery.

AQUATIC ECOLOGY

QUESTION 3

What influence will the plant's thermal discharge have on nuisance blue-green
2 algae, as currently their levels are high? Are nuisance blooms to be expected
at various times of the year?

RESPONSE

According to the Company's aquatic ecology studies[a,b], diatoms and green
12 algae are the dominant forms of algae in the receiving waters. Blue-green
2 algae levels are not high.

10 While it is conceivable that during blowdown the growth of blue-green algae
2 could be enhanced in pools along the bank of the river due to the thermal
10 effluent, it is most likely that this enhancement would occur only during warm
river water temperature seasons. The extent of such activity would be limited
12 to the area of the thermal plume. In addition, during warm river temperature
seasons the amount and period of warmwater discharge will be minimal.
Therefore, no significant enhancement of nuisance blooms is anticipated.
10

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12 (a) H L Lenon, et al, Survey and Evaluation of the Water Quality,
10 Tittabawassee River, near Midland, Michigan, 1978-1979 (April 1979), Central Michigan University.

12 (b) Lawler, Matusky and Skelly Engineers, Aquatic Assessment of the Tittabawassee River in the Vicinity of Midland, Michigan (May 1980).

AQUATIC ECOLOGY

QUESTION 8

From comparisons of average monthly Tittabawassee River temperatures (ER, Table 5.1-3) and monthly maximum temperatures in °F at the edge of the mixing zone allowable for streams capable of supporting warm water fish (ER, p. 5.1-2), it appears Midland Station discharges would occasionally exceed these limits, i.e., January, February, August, and December. What precautions or procedures will be followed to prevent the maximum allowable temperatures from being exceeded?

RESPONSE

The cooling pond Automatic Makeup and Blowdown System (AMBS) is designed to control blowdown to the river so as to be in compliance with Michigan Water Quality Standards (see Section 5.1.1) at all times. To achieve compliance with maximum monthly temperature limits, the pond blowdown valves are automatically positioned to limit flow so as not to exceed the calculated
12 maximum allowable flow based on hydrothermal model studies of the Midland Plant cooling pond discharge and the Tittabawassee River[a]. Blowdown is terminated if monthly maximum river temperatures exist or if blowdown would increase the temperatures at the edge of the mixing zone above the monthly maximum.

(a) Alden Research Laboratories, Investigation of a Thermal Plume in a Shallow River - Hydrothermal Model Studies - Cooling Pond Discharge - Midland Nuclear Power Station (April 1979).

AQUATIC ECOLOGY

QUESTION 13

Provide the entrainment and impingement data collected to date, in summarized
3 form if possible. Indicate method of collection, sampling frequency and pumping.

RESPONSE

Data provided in this response were summarized from Central Michigan University, H L Lenon, et al, Survey and Evaluation of the Water Quality,
12 Tittabawassee River, Near Midland, Michigan, 1978-1979 (April 1979), Central Michigan University and I H Zeitoun, et al, Assessment of Impingement During Initial Pumping to the Midland Plant Cooling Pond (1979), Consumers Power Company, Environmental Services Department.

3 ENTRAINMENT

Method of collection is described in revised ER Section 6.1.1.2.1.

10 Sampling Deviations

Initially, entrainment samples at the pond were not taken directly in front of the discharge pipe to the cooling pond due to the force of the water on the
12 nets but were taken in shallow streams of water flowing down the slope below the discharge pipe to the cooling pond. As the pond level rose above the discharge pipe to the cooling pond so that the velocity of water was not so
10 great, sampling was carried out directly in front of the discharge pipe to the cooling pond as planned (starting April 25, 1978).

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 1b

Assuming Midland is operating in fiscal 1981, give the following costs: 1) fuel, 2) operating and maintenance, 3) other, 4) total. If Midland nuclear costs are different than the nuclear costs in Question #1a, please explain. Use 1978 dollars.

RESPONSE

2 Since the project involves two units and both units are assumed to operate in
12 1984, the costs of operation[(a)] will be given for that year. The costs in
2 1984 dollars are estimated as follows:

12

		($ x 10^6)	Mills/kWh
Fuel	=	$ 69.7	10.4
O&M	=	39.0	5.8
Insurance	=	[illegible].4	1.0
Fixed Charges[(b)]	=	318.3	47.5
Total		$433.4	64.7

(a) Includes electric costs only.

(b) Based on levelized fixed charge rate.

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 4

For Schedule 433a, Form 1, please further provide the breakdown of kilowatt hours generated (line 12), fuel costs (line 21), and production costs other than fuel (line 34 minus line 21) for each of the fuel types for each of the plants (when there is more than one fuel type).

RESPONSE

See attached Table B-C 4-1 for requested information on Schedule 432a, Form 1.

Table B-C 4-1 provides production costs other than fuel for each plant but not by fuel type as costs are not recorded in that manner. Each of the steam plants is essentially either coal burning only or oil burning only. The only exceptions to this are: (1) coal burning plants utilizing auxiliary oil (in some instances for minor amounts of generation); (2) the D E Karn Plant;
12 (3) the J C Weadock Plant; and (4) the B E Morrow Plant. In the case of the D E Karn Plant, Units 1 and 2 are coal fired units and Units 3 and 4 are oil fired and the information included in the Annual Report to the Federal Energy Regulatory Commission is reported in this manner. The J C Weadock Plant utilizes oil in Units 1 through 6 and coal in Units 7 and 8. Booked expenses are recorded in this manner and other production expenses applicable to Units 1 through 6 and Units 7 and 8 are included in the information provided. In December 1979, Units 3 and 4 of the B E Morrow Plant were converted to gas
12 usage. Prior to that time, all units were oil fired. Other production expenses at this Plant are not reported by unit.

TAB

FURTHER BREAKDOWN
GENERATING PLANT
FROM SCHE

Steam

	B C Cobb Units 1-3	B C Cobb Units 4&5	B C Cobb Total	J R Whiting	D E Karn Units 1&2
1978: kWh Generation					
Coal	1,187,068,500*	1,826,632,300*	3,013,700,800	2,037,447,500*	2,737,489,400*
Oil	814,100*	2,423,900*	3,238,000	1,599,500*	9,339,600*
Gas	-	-	-	-	-
Total	1,187,882,600*	1,829,056,200*	3,016,938,800	2,039,047,000*	2,746,829,000*
Fuel Costs ($)					
Coal	18,080,201	21,476,807	39,557,008	32,542,981	33,448,849
Oil	63,253	64,497	127,750	64,828	317,142
Gas	-	-	-	-	-
Total	18,143,454	21,541,304	39,684,758	32,607,809	33,765,991
Production Cost Excluding Fuel ($)	3,314,889	6,700,147	10,015,036	7,308,241	11,689,704
1979: kWh Generation					
Coal	1,036,794,100*	2,230,961,000*	3,267,755,100	2,021,467,700*	3,313,465,600*
Oil	939,700*	2,192,000*	3,131,700	1,191,300*	15,662,400*
Gas	-	-	-	-	-
Total	1,037,733,800*	2,233,153,000*	3,270,886,800	2,022,659,000*	3,329,128,000*
Fuel Costs ($)					
Coal	18,230,974	30,944,053	49,175,027	36,625,924	43,466,308
Oil	38,305	56,628	94,933	46,177	678,547
Gas	-	-	-	-	-
Total	18,269,279	31,000,681	49,269,960	36,672,101	44,144,855
Production Cost Excluding Fuel ($)	3,972,823	4,594,446	8,567,269	6,689,218	8,965,952
1980: kWh Generation					
Coal	765,933,700*	1,739,676,600*	2,505,610,300	1,935,452,100*	3,248,109,700*
Oil	1,472,300*	2,735,500*	4,207,800	1,148,900*	8,739,300*
Gas	-	-	-	-	-
Total	767,406,000*	1,742,412,100*	2,509,818,100	1,936,601,000*	3,256,849,000*
Fuel Costs ($)					
Coal	14,874,214	27,194,414	42,068,628	38,829,658	57,742,448
Oil	81,266	100,860	182,126	119,506	491,068
Gas	-	-	-	-	-
Total	14,955,480	27,295,274	42,250,754	38,949,164	58,233,516
Production Cost Excluding Fuel ($)	4,585,163	5,466,546	10,051,709	11,547,403	8,557,885

*Allocated on Btu Basis

REVISION 12 - JUNE 1981

E B-C 4-1

F SELECTED STEAM-ELECTRIC
TATISTICS (LARGE PLANTS)
ULE 432a, FORM 1

enerating Plants

J H Campbell		J C Weadock				Combustion Turbine Plants	
Units 1&2	Unit 3	Units 1-6	Units 7&8	Total	B E Morrow	Gaylord	Thetford
,685,770,100*		-	1,404,727,300*	1,404,727,300	-	-	-
6,480,300*		455,590,900	3,025,700*	458,616,600	279,764,000	1,667,900*	17,266,300*
-		-	-	-	-	151,316,300*	313,982,400*
,692,250,400*		455,590,900	1,407,753,000*	1,863,343,900	279,764,000	152,984,200*	331,248,700*
44,836,497		-	18,927,753	18,927,753	-	-	-
260,819		17,671,676	105,959	17,777,635	9,229,439	75,043	676,551
-		-	-	-	-	4,342,181	10,012,886
45,097,316		17,671,676	19,033,712	36,705,388	9,229,439	4,417,224	10,689,437
6,606,291		4,772,072	10,508,995	15,281,067	3,260,497	591,531	2,020,275
470,259,100*		-	1,834,924,500*	1,834,924,500	-	-	-
5,822,100*		111,017,900	5,032,500*	116,050,400	108,839,500*	6,400*	107,900*
-		-	-	-	6,767,200*	82,306,000*	240,618,080*
,476,081,200*		111,017,900	1,839,957,000*	1,950,974,900	115,606,700*	82,312,400*	240,725,980*
48,141,475		-	25,801,175	25,801,175	-	-	-
73,886		6,599,556	332,404	6,931,960	4,976,813	291	4,810
-		-	-	-	344,000	2,880,312	9,021,874
48,215,361		6,599,556	26,133,579	32,733,135	5,320,813	2,880,603	9,026,684
11,907,093		4,137,684	6,495,713	10,633,397	2,092,650	615,895	1,912,077
,230,692,600*	1,074,950,800*	-	1,771,453,100*	1,771,453,100	-	-	-
3,906,300*	40,398,100*	29,049,300	4,037,900*	33,087,200	12,464,000*	-	15,900*
-	-	-	-	-	160,97[illegible],900*	45,322,000*	150,871,680*
,234,598,900*	1,115,348,900*	29,049,300	1,775,491,000*	1,804,540,300	17[illegible],443,900*	45,322,000*	150,887,580*
49,533,699	21,683,342	-	32,780,172	32,780,172	-	-	-
146,38[illegible]	2,606,438	3,543,343	346,411	3,889,754	614,054	-	617
-	-	-	-	-	6,196,504	2,127,157	6,152,149
49,680,084	24,289,780	3,543,343	33,126,583	36,669,926	6,810,558	2,127,157	6,152,766
13,324,626	1,831,757	2,637,943	9,638,791	12,276,734	1,573,735	[illegible]61,964	973,882

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 5

What was the average delivered cost of coal per BTU and in mills per kilowatt hour delivered to the calendar system in 1977 for 1) low sulfur coal (<.7%) and 2) high sulfur coal (>3%)?

RESPONSE

No low sulfur coal (<0.7%) of any consequence was purchased by Consumers Power during 1977.

For those units burning high sulfur coal (>3%) the 1977 delivered cost
12 averaged 97.96¢/(Btu x 10^6) and 1.119 mills per kWh.

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 8

Please provide the forced outage rates for each size of units, or alternatively, provide forced outage rate data for each unit (by type and size
2 for the system).

RESPONSE

Following is a list of the ROR (random outage rates) projected for the period
11 1984-85. ROR is defined as:

$$ROR = \frac{F + U}{T - P}$$

2 where: T = Installed Capability x Time, (MW x Time)

F = Forced Outage (Actual) x Time, (MW x Time)

P = Period Outages (Actual) x Time, (MW x Time)

U = Unforeseen Outages (Actual) x Time, (MW x Time)

	Coal	Size(MW)	1984 ROR	1985 ROR
11 2				
11	Campbell 1	253	15.3	13.0
	Campbell 2	340	18.0	16.0
12	Campbell 3	778	13.5	15.0
	Cobb 1-3	180	10.0	10.0
	Cobb 4	151	11.0	12.0
11	Cobb 5	152	9.2	13.0
	Karn 1	255	19.4	19.0

		Size(MW)	1984 ROR	1985 ROR
11, 2	Coal			
11	Karn 2	257	15.6	16.0
12	Weadock 7	155	7.0	9.0
	Weadock 8	155	11.0	9.8
	Whiting 1	95	9.4	7.4
11	Whiting 2	95	5.7	5.7
	Whiting 3	120	9.6	10.0
2	Oil			
	Karn 3	638	12.0	10.0
12	Karn 4	613	14.0	14.0
2	Nuclear			
	Big Rock	63	3.8	3.7
	Palisades	740	24.4	25.4
12	Midland 1	522	32.9	32.6
	Midland 2	807	37.3	41.5
2, 12	Peakers (20 Units)	504	16.0	14.0
2, 12	Ludington Pumped Storage[(a)] (6 Units)	954	4.0	4.0
2, 12	Hydro (35 Units)	133.6	2.8	2.8

2 (a) Reflects CP Co 51% share.

2 BENEFIT-COST ANALYSES AND NEED FOR POWER

2 QUESTION 9b

2 Please provide the anticipated loading order of units available to CPS for

2 each of the seasons of the year.

2 RESPONSE

2 Units are dispatched on an economic priority basis regardless of season. The

2 anticipated loading of steam-electric and combustion-turbine units available to Consumers Power Company in 1984 is:

PAL
11 BIG R
MID 1
MID 2
CAMP2
CAMP1
COBB5
COBB4
12 CAMP3
WHIT3
11 KARN2
KARN1
12 WEAD7
11 WHIT1
WHIT2
12
11 WEAD8
COBB1
12 COBB2
COBB3
11 KARN4
KARN3
TH1-4
12 MORRA
MORRB
11 WEADA
GAYLD
12 TH5-9

11 | STRAT
12 |

11 | WHITA
CAMPA

2 | Hydroelectric units are typically dispatched run-of-river with regard to regulations established for their operation. Pumped-storage units are dispatched on an economic and energy-related criteria. Therefore, exact loading cannot be depicted.

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 10a

(referring to previous question 10) Please provide the expected hourly load (in MWh) of the Dow Chemical in the first full year of operation of Midland, for the weeks in April, August, and December which are used in Form 12, Schedule 15. Also provide this d for the hottest and coldest week of the year, if there are notable (>10%) differences.

RESPONSE

2

The Dow Chemical Company's current (August 1980) best estimate of power
12 consumption at their Midland Plant in 1984 is an average demand of about
95 MWe.

The Dow Chemical Company cannot accurately predict power use this far in
advance for any specific month. Their power use is primarily affected by
3 production activity and The Dow Chemical Company is not able to predict sales
demand by the month that far in the future.

Seasonal changes in power use are not significant[a].

(a) The above data were provided by James R Burroughs, The Dow
12 Chemical Company to P C Webb, Consumers Power Company, in September
1980.

BENEFIT-COST ANALYSES AND NEED FOR POWER

QUESTION 15

Please provide the estimated GNP annual growth rate and GM vehicle production growth rates used to forecast GM electric sales. These growth rates should indicate the percent growth for the 1977-1982 and 1982-1987 periods.

RESPONSE

3

4 The average annual growth rates of GNP and GM vehicle production used in the October 1980 update of the CP Co electric sales forecast are summarized below.

12

4

	Average Annual Growth Rates 1977-82	1982-87
12 Real GNP	2.1%	3.4%
GM Vehicle Production	-0.5%	3.6%

ENDANGERED SPECIES

QUESTION 1

Identify and discuss the methodology and/or survey method used to insure that operation of the transmission lines and plant facility will not violate the Michigan Endangered Species Act of 1974, Public Act No 203, which prohibits the "taking" of any state listed endangered or threatened animals or plants. List reference sources and all authorities consulted.

RESPONSE

3

4 An ecological survey designed to include sampling of flora and fauna in all plant community types traversed by the Midland to Kenowa-Thetford transmission line right-of-way was initiated on September 20, 1978, and completed on
10 September 14, 1979. Sampling included fall, spring, and summer samples. The
4 scope and timing of the survey are reflected in the attached portions of the
10 scope statement. As evidenced in this statement, special emphasis was placed
4 on those species considered to be "important" under US NRC Regulatory Guide 4.2, Section 2.2, Ecology.

12 The final report was completed November 10, 1979. Six copies were provided to the Nuclear Regulatory Commission on September 15, 1980.

10 The consultants contacted the Endangered Species Office of the Michigan Department of Natural Resources' Wildlife Division to identify those species
4 of plants and animals deemed to be endangered, threatened, rare or scarce in Saginaw, Bay and Midland counties. These species together with their habitat

12 requirements and phenological data for plants are listed in Table 4.2-2. Specific information regarding the known localities of these species in the
4 subject counties was also obtained but is not reproduced here. The principal contact for the consultants in the Michigan Department of Natural Resources' Endangered Species Office was Dr Sylvia Taylor. The several taxonomic specialists who were contacted regarding identification of specimens include:

1. Dr Rollin Baker, Professor of Zoology, Michigan State University.

10 2. Fred Case, author of Orchids of the Great Lakes Region, and member of the Department of Natural Resources Technical Committee on threatened plants.

3. Dr William Redding, botanist, Grand Valley State College.

4. Dr Edward Voss, botanist, University of Michigan.

No endangered or threatened species or their critical habitats were
4 encountered on the right-of-way during this survey; no preoperational or operational surveys are planned which would further seek to locate such
10 species.

ENDANGERED SPECIES

QUESTION 2

What state listed species were considered in your assessment of impacts to endangered and threatened biota? Provide all information (ie, consultations, letters, surveys, etc) used to support your conclusion, stated in Section 4.2.6 of the OL-ER, that this state list does not "include any animals that are expected to be affected by the construction of the Midland Plant transmission lines."

RESPONSE

3

12 The State listed species originally considered in Section 4.2.6 of the ER are
4 those species which were considered in References 7 and 8 of that Section. The State list for 1974-1976[a] was essentially a reiteration of the Secretary
12 of Interior's Endangered Species List, and included four terrestrial vertebrates in Michigan:

a) Indiana bat (Myotis sodalis).

b) Eastern timber wolf (Canis lupus lycaon).

4 c) Peregrine falcons (Falco peregrinus anatum and Falco peregrinus tundrius).

d) Kirtland's warbler (Dendroica kirtlandii).

Information from this list regarding the ranges and biology of these species indicates an extremely small probability that these species would be found in the vicinity of the Midland Plant and associated transmission lines.

4 Pursuant to Section 4 of Public Act No 203 of Public Acts of 1974, State of Michigan, the Director of the Michigan Department of Natural Resources issued a revised list of State threatened and endangered species for the two-year period of 1976-1978. This list was not officially accepted until October 14, 1976[b], and was not available to the general public until a later date. This list was not considered in the Midland ER until Revision 4, December 1978.

12

The State listed[c] threatened and endangered species for Bay, Midland and
4 Saginaw Counties, together with the habitat requirements of each species, are
12 presented in Table 4.2-2. At the request of representatives of the Michigan Department of Natural Resources, known localities of these species in the State or, more specifically, within the subject counties are not given in
4 order to protect certain species from collectors and the general public.

---

12 (a) Michigan Department of Natural Resources, Michigan's Program for Endangered and Threatened Species (1974), State of Michigan.

4 (b) Memorandum to the Natural Resources Commission from David H Jenkins (Wildlife Division), Henry J Vondett (Fisheries Division), and Howard A Tanner (Director Michigan Department of Natural Resources), October 14, 1976.

12 (c) Michigan Department of Natural Resources, Michigan Endangered and Threatened Species List, promulgated in accordance with Act 203, PA 1974; Administrative Rules attached as Article 299.224, R299.1021-R299.1028, as amended, February 5, 1980.

ENDANGERED SPECIES

QUESTION 3

Describe methodology and/or survey method that will be used for the preoperational and operational monitoring programs to insure that operation of the transmission lines and plant facility will not violate the Federal Endangered Species Act and Michigan Endangered Species Act.

RESPONSE

3

Preoperational and operational monitoring programs are detailed in revised ER
Sections 6.1.4.3 and 6.2A-3.1.2.2, respectively. These programs emphasize the
4 analysis of the possible impact of Plant operation on "important" species,
which by definition includes endangered and threatened species. If endangered
12 or threatened species are encountered during preoperational or operational
4 studies, methodologies will be supplemented to determine what effect, if any,
the operation of the Midland Plant may have on the continued existence of
12 these species.

ENDANGERED SPECIES

QUESTION 4

Provide a list of all listed or proposed Michigan State endangered and threatened species for Bay, Midland and Saginaw Counties. Also, provide the distribution range and habitat requirements of each species occurring in these three counties.

RESPONSE

3

12 A list[a] of all listed or proposed Michigan State endangered or threatened
4 species which may occur in Bay, Midland, and Saginaw Counties is presented in
12 Table 4.2-2. No additions to this list will be proposed until the fall of
1981. This information was obtained from the Michigan Department of Natural
Resources (MDNR) Endangered Species Office, Wildlife Division. While
preliminary county maps of endangered and threatened plants do exist, they are
4 not included in this response. The MDNR has requested that this information
not be released to the general public at this time because of the preliminary
nature of the data and a desire to protect vulnerable species from collectors.
At the present time, no county by county list or map is available for Michigan
mammals or birds. The mammalian and avifauna species in Table 4.2-2 are those

12

(a) Michigan Department of Natural Resources, Michigan's Endangered and Threatened Species List, promulgated in accordance with Act 203, PA 1974, Administrative Rules attached as Articles 299.224, R299.1021-R299.1028, as amended, February 5, 1980.

which might be found iu Bay, Midland and Saginaw Counties based upon habitat
4 requirements. The habitat requirements of endangered and threatened plants
and animals are also listed in that Table.

HYDROLOGY, WATER USE AND WATER QUALITY

QUESTION 2

Provide the most recent available water quality data from ongoing monitoring
2 programs for surface and ground water in the site vicinity.

RESPONSE

Refer to ER Section 2.4.6.1 for a summary and reference to the most recent available surface water quality data. In addition, ER Table 3.6-3 has been revised to include the latest available data from the Applicant's river water quality sampling program conducted during 1979.

12

Groundwater quality data are currently being analyzed for 1980. Data collected during 1978 and 1979 are provided in ER Section 2.4.7.2.3.

HYDROLOGY, WATER USE AND WATER QUALITY

QUESTION 9

Indicate what biocide or scheme will be used for algae control within the
4 cooling pond considering the effects of total dissolved solids (TDS).

RESPONSE

Please refer to ER revised Section 5.6.2.
12

SOCIOECONOMICS

QUESTION 10

Provide the projected annual employment schedule at Midland and, if available, Dow Chemical during the operating period of the Midland Plant. If this information is not available, provide the current employment profile at Midland Plant and Dow Chemical, including:

- number of workers employed
- number of relocated workers
- residential location of the relocated workers by town
- percentage of housing types occupied by the relocated workers (rental, single unit, group quarter, etc)
- percentage of single workers and married workers, family size
- school-age children (preschool, kindergarten, junior high, etc)
- relocated children's enrollment by school district

RESPONSE

3

As of (August 1980) the latest employment at The Dow Chemical Company Midland
12 Manufacturing Plant had 5,915 employees. The Dow Chemical Company is unable
to project annual employment at its Midland plant during the operating period
4 of the Consumers Power Company Midland Plant. However, at the present time
The Dow Chemical Company does not anticipate any significant increase or
decrease in employment at its Midland plant in the foreseeable future.

12

Refer to revised Section 8.1.5 of the Environmental Report for Consumers Power Company's projected annual employment schedule at the Midland Plant during the

4 operating period. Refer to revised Section 8.2.7 for the resultant socioeconomic costs.

SOCIOECONOMICS

QUESTION 12

Provide an estimate of property and income tax payable to local and state jurisdictions during the operating life of the Midland Plant (update Page 8-1 of Enclosure 1 in the April 1, 1977 letter to William H Regan, if necessary). The estimates should indicate these taxes, in 1978 dollars, for each operating year along with the total taxes paid during the operating life of the plant.

RESPONSE

3

4 The estimates of State and local taxes applicable to the Midland Plant are
12 provided by employing components of a fixed charge rate. Since these
4 estimates are levelized annual values, they should not be used for planning
12 purposes. Moreover, they are system average estimates rather than site specific estimates.

4 a. Michigan Single Business Tax
12 1984 Levelized Annual Payment = $2.7 million

4 b. Property Taxes
11 1984 Levelized Annual Payment = $62.0 million

4 c. No special district taxes

11 Refer to revised ER(OLS) Sections 8.1.4, 8.2.6 and 11.

SOCIOECONOMICS

QUESTION 13

Provide an estimate of the average operation-related expenses during the operating period. Indicate the expected average expenditures in the three counties of Midland, Saginaw and Bay, for materials, services and equipment and the discount rates used to determine the average.

RESPONSE

3

12 Refer to revised Sections 8.1.5, 8.2 and revised Table 11-2 of the Environmental Report.

TERRESTRIAL ECOLOGY

QUESTION 2

Provide vegetation maps of the offsite vegetation within at least 3 km (2 mi) of the site boundary. Where possible, use the same vegetation mapping units as were used for ASER (Ecological Survey of Midland Plant Site by Gysel and Reichard, 1971) and the OL Stage ER. Provide descriptions of any and all mapping units other than those in the ASER. These descriptions should be comparable to the descriptions of the preconstruction vegetation (ASER).

RESPONSE

Vegetation mapping in the indicated area has not been conducted. Following the aquation of preoperational black and white and infrared photography of vegetation within 3 km of the Plant, vegetation will be mapped according to the Michigan Land Cover/Use Classification System[a]. This system, in the present application, will be used in lieu of that used by Gysel and Reichard because: (1) lack of access to private land precludes the use of a system as
12 detailed as that used by Gysel and Reichard; the Michigan Land Cover/Use Classification System is less complex and stresses dominant tree species, which allows mapping through aerial photograph interpretation, and (2) the Michigan Land Cover/Use Classification System is widely used by State agencies. There are advantages to the use of a standard system where the mapping units are well-known and understood by a variety of users. Aerial photography and vegetation mapping are planned for spring and summer 1981.

(a) Michigan Land Use Classification and Referencing Committee, Michigan Land Cover/Use Classification System, July 1975 (revised January 1976).