Chapter 9 Alternatives to the Proposed Action

The proposed action is issuance of a Combined License (COL) by the U.S. Nuclear Regulatory Commission (NRC) to Detroit Edison to construct and operate a new baseload nuclear powered electrical generating facility at the Fermi site (Fermi 3). Detroit Edison's objective is to obtain a COL for Fermi 3. If Detroit Edison receives a COL and decides to construct this facility, this would also enable Detroit Edison to further utilize a site that it currently owns.

This chapter describes the alternatives to construction and operation of a new nuclear powered electrical generating facility at the Fermi site and alternative power plant and transmission systems. The following descriptions provide sufficient detail for the reader to evaluate the impacts of these alternative generation options or power plant and transmission systems relative to those of Fermi 3.

The chapter is divided into four sections:

- No-Action Alternative (Section 9.1)
- Energy Alternatives (Section 9.2)
- Alternative Sites (Section 9.3)
- Alternative Plant and Transmission Systems (Section 9.4)

9.1 No-Action Alternative

The no-action alternative is taken here to mean that such factors as the denial of the necessary Federal, State, regional, local, and/or affected Native American tribal agency permits, financing, or some other factor unrelated to the need for electrical power could lead to Detroit Edison's decision not to proceed with the construction and operation of the proposed facility, even though the facility is needed.

Detroit Edison's intent, consistent with the intent of 10 CFR 52, is to obtain a COL for the potential future construction and operation of a new nuclear powered electrical generating facility at the Fermi site, i.e., Fermi 3. In accordance with the intent of 10 CFR 51 (Subpart A, Appendix A.4), this section describes the no-action alternative as well as the impacts that would result if the no-action alternative is chosen (i.e., need for electrical power is not satisfied by construction and operation of Fermi 3).

Chapter 8 provides an assessment of the need for new baseload electrical generation. As discussed in Section 8.2, electricity demand in the State of Michigan is expected to increase approximately 1.2 percent annually for the foreseeable future. Detroit Edison operates within the ITC*Transmission* service area. ITC*Transmission* operates within the Midwest Independent Service Operator (Midwest ISO) regional reliability area as discussed in Chapter 8. Without adding electrical power generating capability, the Midwest ISO would not be able to maintain adequate reserve electrical power margin. Detroit Edison provides most of the electricity used in southeastern Michigan. If Detroit Edison took no action at all to meet growing electricity demands, the ability of Detroit Edison to continue to supply low-cost, reliable electrical power to its customers would be impaired. Consequently, it would be irresponsible for Detroit Edison or the State of Michigan to take no action at all to meet the growing demands for electricity.

As evaluated in Chapter 8 and summarized in Section 8.4, it is shown that the Midwest ISO must add baseload generating capacity to meet current and projected supply role deficit. Furthermore, as also discussed in Chapter 8, Detroit Edison (the primary supplier of electricity to southeast Michigan) must add baseload generating capacity to meet project supply deficits. The cancellation of this project along with no action to replace (owner-controlled) capacity or purchase power could (1) prevent Detroit Edison from ensuring a reliable supply of baseload energy, (2) compromise its ability to meet baseload energy needs at an economic price, and (3) increase the State of Michigan's exposure to price volatility associated with reliance on natural gas-fired generation and power purchases.

Given the need for power demonstrated in Chapter 8, in the absence of the proposed generation capability, Detroit Edison and the State of Michigan would have to take action to meet reliability goals and service area power needs, in order to mitigate adverse impacts to consumers and to the broader economic productivity of the region. Without having the proposed facility as an electrical power resource, Detroit Edison could be forced to consider and/or pursue alternate ways of fulfilling the need for electrical power as discussed below:

- Detroit Edison may choose not to pursue construction of any new electricity generation capacity at the Fermi site, and thus the need for electrical power presumably must be met by other alternative means that involve no new electricity generating capacity. These alternatives would include such approaches as curtailment of electrical power, demand-side management, energy conservation, and power purchased from other electricity providers. Considerable uncertainty is involved in the treatment of a number of time-sensitive factors normally considered in such an assessment. However, with the recognition of factors shaping decisions in the marketplace, alternatives involving no new electricity generation capacity are possible. This evaluation is discussed in Section 9.2.
- The required electrical power could be provided by the construction of new electricity generating capacity using other generating alternatives rather than nuclear power. The new capacity may be constructed at the Fermi site or at other, non-designated, "greenfield" sites. Assessments of these alternatives are provided in Section 9.2, including combinations thereof. It should be noted that Detroit Edison's purpose in seeking the COL is to support future construction and operation of a new nuclear powered electrical generating facility at the Fermi site. This purpose is not only consistent with Detroit Edison's overall business, but also socioeconomic development and environmental protection strategies.
- It is also possible that some combination of the above approaches could be taken to provide the equivalent of the electricity generating capacity lost by pursuing the no-action alternative. For example, the needed capacity could be obtained by a certain amount of new gas turbine electricity generation, combined with the purchasing of electricity from outside the Detroit Edison system. Potential combinations of alternative energy sources are considered in Section 9.2.

Section 10.4 evaluates the overall benefit and cost of the proposed new facility. If the proposed facility was not constructed or operated, then the associated costs would not be incurred. However, as the overall assessment concludes that the project represents a significant benefit, it follows that these additional benefits would not be realized under the no-action alternative.

9.2 Energy Alternatives

This section provides an analysis of possible alternatives to new nuclear generation of Fermi 3.

Subsection 9.2.1 discusses possible alternatives that do not require new generating capacity. Subsection 9.2.2 discusses possible new generation alternatives. In Subsection 9.2.2, some of the alternatives that require new generating capacity are eliminated from further consideration and discussion based on their availability in the region, overall feasibility, ability to supply baseload power, or environmental consequences. Subsection 9.2.3 discusses the specific alternatives, in more detail, that were not eliminated in Subsection 9.2.2. These possible alternatives are investigated in further detail relative to specific criteria such as environmental impacts, reliability, and economic costs. Subsection 9.2.4 provides a summary and conclusions for this evaluation of energy alternatives.

The information in this section relies, in part, on information in Chapter 8. Chapter 8 demonstrates the need for power and related benefits to be generated by Fermi 3. The following information is included in Chapter 8, however, where appropriate, in lieu of repeating information in this chapter, cross-references are provided to the information in Chapter 8.

Section 8.1 provides a description of the power system, an overview of the pertinent service area and a discussion of regional relationships. Sufficient detail is provided to gain an understanding of the configuration in the State of Michigan and relationships with other entities.

Section 8.2 provides a description of the analysis performed to determine current and forecasted energy needs in the State of Michigan. The energy forecasts represent the aggregate product of individual forecasts made by investor-owned, municipal, and cooperative utilities. In addition to assessing a base case growth forecast, cases considering low growth and high growth have also been performed. Section 8.2 also discusses factors that can affect growth of demand; i.e., forecasting uncertainties, energy efficiency and conservation.

Section 8.3 provides a description of the analysis performed to determine energy supply resources. Energy supply resources consist of the existing generating capability plus forecasted generating capability plus (or subtracting) transmission capabilities in (or out) of the service area and subtracting forecasted unit retirements.

Section 8.4 provides a description of the assessment of the need for power. The assessment of the need for power balances the current and forecasted demand against the current and forecasted supply, while demonstrating that an adequate reserve margin is maintained. The assessment includes several different scenarios and sensitivities to provide a comprehensive and rigorous evaluation.

Pursuant to Executive Directive No. 2006-02 (Reference 9.2-30), the Michigan Public Service Commission prepared and issued Michigan's 21st Century Electric Energy Plan (Reference 9.2-3). The plan is comprehensive in its scope and inclusive in its development. It was developed with input from more than 150 organizations. Interested persons were divided into four Workgroups – the Capacity Need Forum Update Workgroup, the Energy Efficiency Workgroup, the Renewable Energy Workgroup, and the Alternative Technologies Workgroup. These four Workgroups were further subdivided into Teams. In all, over 35 Workgroup/Team meetings and five large group meetings were held, and approximately 4000 pages of documents were filed with, or prepared by, the Public Service Commission Staff. The website cited as part of Reference 9.2-3 was used to post relevant information. Workgroup reports, membership list, presentation handouts, participant's comments, and other draft documents can be found on the website. The final Workgroup reports are found in Reference 9.2-3, Appendix Volume II.

The 21st Century Electric Energy Plan satisfies the evaluation criteria of being (1) systematic; (2) comprehensive; (3) subject to confirmation and; (4) and responsive to forecast uncertainty. The plan extends beyond Detroit Edison's direct service area and addresses the needs for the State. The planning period extends to 2025, or well beyond the planned date of commercial operation for Fermi 3. The bases for these conclusions are discussed in Subsection 8.1.5.

In addition to establishing the need for new baseload generation, it evaluates the means to provide for the baseload generation. The plan analysis is summarized in Section 8.4. The plan analysis is considered to reasonable and meets high quality standards. The plan analysis of alternative energy supplies considers both renewable and non-renewable fuels.

9.2.1 **Alternatives Not Requiring New Generating Capacity**

This subsection is meant to provide an assessment of the economic and technical feasibility of meeting energy demand without building a new nuclear facility. Alternatives to a new nuclear facility include the following elements:

- Power purchases from other utilities or power generators (Subsection 9.2.1.1)
- Plant reactivation or extended service life (Subsection 9.2.1.2)
- Conservation or demand-side management measures (Subsection 9.2.1.3)
- Any combination of these elements that would be equivalent to the output of the project and therefore eliminate the need (Subsection 9.2.1.4)

9.2.1.1 **Power Purchases**

The amount of additional generating capacity required in the East Central Area Reliability Coordination Agreement area is expected to be approximately 20,000 Megawatts between 2006 and 2030 (Reference 9.2-1). Section 8.4 summarizes the capacity additions that are needed for the forthcoming 10 and 20 year time periods in order to satisfy target reliability levels and reserve margin requirements in the State of Michigan. The discussion in Section 8.4 is based on analyses performed to support Reference 9.2-3. The Base Case analyses summarized in Section 8.4 conclude that in order to satisfy target reliability and reserve margin requirements, an additional

10,000 to 11,000 MWe will be needed to be added in the next 20 years. Section 8.3 discusses the capability for purchases for providing power to the State of Michigan, concluding that the current capacity and options being considered can provide part of the projected need.

If power to replace the capacity of a new nuclear facility were to be purchased from sources within the United States or a foreign country, the generating technology would likely be one of those described in Subsection 9.2.2 (likely coal, natural gas, or nuclear). The description of the environmental impacts associated with the construction and operation of other technologies is discussed in Subsection 9.2.2. The environmental impacts from the generation source of the purchased power alternative would still occur, but the impacts would occur somewhere else in the region, nation, or in another country.

If the purchased power alternative is implemented, the environmental impacts of any new transmission rights-of-way are unknown. As discussed in Subsection 8.3.2, new transmission is being considered in the State of Michigan. The effects of the postulated new transmission capability are factored in the evaluations summarized in Section 8.4. The environmental impacts of the power generation would be unknown due to the unknown technology and location of the power generation (Reference 9.2-2).

As discussed in Section 8.4, the modeling performed included several different scenarios and sensitivities. One of the sensitivities considered is expanded transmission capability. As discussed in Reference 9.2-3, the expanded transmission capability sensitivity was not included beyond the Base Case scenario for economic reasons. Furthermore, as discussed in Reference 9.2-3, one of the objectives of the State of Michigan is to “avoid undue reliance on energy produced by other states.” Thus, reliance on electrical power produced outside of the State of Michigan is contrary to the objectives of Reference 9.2-3.

Accordingly, purchasing power from other utilities or power generators is not considered a reasonable or environmentally preferable alternative to Fermi 3.

9.2.1.2 **Plant Reactivation or Extended Service Life**

The power plants that would likely provide capacity equivalent to the proposed Fermi 3 would be coal-fired or natural gas-fired power plants. Subsection 8.3.3 discusses potential retirements of baseload units in the State of Michigan. As of January 2007, Michigan’s baseload power plants are an average of 48 years old. Fossil-fueled plants slated for retirement tend to be ones that are old enough to have difficulty in economically meeting today’s restrictions on air containment emissions and, as a result, would require extensive refurbishment to meet the more restrictive environmental standards at great economic cost. As a result the environmental impacts of a refurbishment scenario are bounded by the coal-fired and natural gas-fired alternatives evaluated in Subsection 9.2.2.

In this region there is not a potential for another nuclear plant to provide an alternative source by reactivation or license renewal. Power uprates for existing nuclear units would not be sufficient to meet the projected demand shortfalls. No nuclear plants are identified for retirement within the time frame discussed in Subsection 8.3.3. Continued operation of a nuclear plant would avoid the environmental impacts related to construction; thus continued operation of an existing nuclear plant would have fewer environmental impacts than the construction of a new plant. However, continued operation of an existing plant does not provide additional generating capacity. Retooling of Fermi 1 as a source of electrical generation is not considered a viable alternative due to plant size and the current state of decommissioning activities.

Therefore, reactivation or extended service life are not considered reasonable and/or environmentally preferable alternative energy sources.

9.2.1.3 **Conservation or Demand-Side Management Measures**

Demand-side management is the practice of reducing customers' demand for energy through programs such as energy conservation, efficiency, and demand management programs so that the need for additional generation capacity is eliminated or reduced. Demand-side management falls into two general categories; active demand management and passive demand response programs. Active demand management refers to action taken by utility to instantly decrease demand. An example of a program using active demand management is Detroit Edison's air conditioning (AC) cycling program. Passive demand management programs rely on prices to incentivize consumer behavior. For example, the utility could provide customers with information regarding rates for various times-of-day, and allow the customer to make the decision to selectively limit use at expensive times. Specific factors related to energy efficiency and conservation are addressed in more detail in Subsection 8.2.2.2.

As part of Reference 9.2-3, the Statewide Utility Load Response programs were extensively analyzed by the Energy Efficiency Workgroup. The concepts of a statewide smart meter implementation and smart rate programs were discussed as resource options. Detroit Edison has a sizable existing residential AC cycling program, with over 284,000 customers (as of January 2007). The results of the study indicate that after 10 years of program expansion, 162 MWe of peak demand reduction would be available, in addition to the 255 MWe of existing program capacity, for a total of 417 MWe. For the purposes of modeling input for the 2025 forecast, extrapolation of the program to 2025 assumed that the maximum cumulative participation rate of 50 percent of the potential market would be reached, resulting in 284 MWe peak demand reduction, in addition to the 255 MWe of existing program capacity, for a total of 539 MWe for a total annual cost during the 20^{th} year of programming of approximately $23.58 million. Consumers Energy does not currently have an existing AC cycling program. Thus, projected demand reductions assume the start up of a new program. The results of Consumers' study indicate that in the 10^{th} year of operation, the program will yield 151 MWe of peak demand reduction. Extrapolation of the program for an additional 10 years yields a projected 215 MWe of peak demand reduction for a total annual cost during the 20^{th} year of programming of $5.19 million.

Section 8.4 demonstrates that the growth in baseload need is projected to be over and above the potential effects of the conservation and energy efficiency. The demand-side management programs described above are aimed at managing the efficiency gains from peak load, not baseload. The impact of these programs, at best, could only moderate load growth and slightly defer the need for additional baseload power, but not the need for Fermi 3 as shown in Section 8.4.

In conclusion, Detroit Edison does not consider conservation alone to be a feasible alternative to the proposed Fermi 3.

9.2.1.4 Combination of Alternative Elements

From an environmental impact standpoint, conservation could be considered in combination with other sources. Combinations of the viable alternatives (i.e., coal and natural gas) are addressed in Subsection 9.2.3. Section 8.4 addresses combinations of alternative elements to provide the required baseload power as part of the discussed sensitivity cases. As shown in Section 8.4 and Reference 9.2-3, combining the effects from conservation and power purchases are not sufficient to provide the necessary baseload power in order to satisfy target reliability levels and reserve margin requirements.

9.2.1.5 Conclusions

Based on the above discussion, there are no economic and technically feasible means of meeting energy demand without constructing a new baseload generation facility. As discussed in Section 8.4, the nuclear option is preferable for providing this need for baseload generation.

9.2.2 Alternatives Requiring New Generating Capacity

This subsection discusses the possible alternative sources of energy and whether they could reasonably be expected to commercially serve Detroit Edison's baseload power needs in a manner that is environmentally preferable to Fermi 3. Each potential resource is assessed in terms of its potential to provide the required baseload power offered by Fermi 3. If a generating source is determined to be viable pursuant to the review in this subsection, it is then compared with Fermi 3 in Subsection 9.2.3. This assessment is premised on the installation of a facility that would primarily serve as a large baseload generator and that any feasible alternative would also need to be able to generate baseload power. This subsection includes assessment of currently available technologies as well as those that are projected to be available within the relevant time frame. Technologies reviewed include fossil fuels, taking into account national policy regarding the use of such fuels, as well as alternate/renewable resources available within the region. Specifically, this subsection covers:

- Renewable Fuels:
  - Wind
  - Solar Technologies: Photovoltaic Cells and Solar Thermal Power
  - Hydropower
  - Geothermal
  - Wood Waste
  - Municipal Solid Waste
  - Other Biomass-Derived Fuels

- Other Alternatives:
  - Integrated Gas-Fired Combined Cycle (IGCC)
  - Fuel Cells
- Non-Renewable Fuels:
  - Oil-Fired
  - Coal-Fired
  - Natural Gas-Fired

During the lifetime of Fermi 3, it is reasonable to expect that technology will continue to improve on its operational and environmental performance. Thus, qualitative or quantitative analyses of future relative competitiveness or impacts are subject to those uncertainties. However, as in the case of alternatives evaluated in Subsection 9.2.1, sufficient knowledge is available at this time to make reasonable comparisons of the alternatives in the principal areas of cost and environmental impacts.

9.2.2.1 **Renewable Fuels**

Generally, renewable resources are not of the scale or type to provide baseload power comparable to the output of Fermi 3. Figure 9.2-1 depicts the role of renewable energy consumption in the United States as a total and as the individual contributors. Table 9.2-1 depicts the average capacity factors achieved by various renewable resource types nation-wide based on data from the Energy Information Administration (EIA). The information in Table 9.2-1 indicates that where viable, most renewable resources are not generally able to provide baseload power or higher capacity outputs equivalent to Fermi 3. The non-baseload nature of these resources may be overcome in the future with the development of nano-supercapacitors, energy storage devices such as compressed air systems or large-scale battery systems, and deployment of significant transmission system enhancements. EPRI forecasts that not until the mid-2020s may nano-capacitor technology become available for deployment (Reference 9.2-4). Large-scale energy storage devices also have not been advanced to the point of economic feasibility. Until these technologies are advanced, non-baseload resources such as solar and wind cannot provide baseload power.

Any comparison of economic or environmental viability between non-baseload or mid-range capacity and baseload capacity would need to account for the diminished average available capacity by proportionately reducing the non-baseload or mid-range capacity ratings by an assumed technology-specific availability rating. However, it is noted that the resulting average available capacity is not equivalent to the reliability of a baseload unit (Reference 9.2-4).

Approximately three percent of the electricity energy currently sold to Michigan utility customers is generated by renewable energy sources. As part of the 21st Century Electric Energy Plan, estimations of the potential renewable energy production were considered. The following renewable sources were considered:

- Landfill Gas

- Anaerobic Digestion – converting organic wastes into methane to be used as fuel
- Cellulosic Biomass, including forestry and agricultural residues
- Wind

Solar electricity production was not explicitly included in the plan modeling since solar has experienced only limited market penetration in Michigan at this time. Although larger scale production and continuing technological improvements are likely to make solar applications more attractive in the future, the staff that developed the modeling scenarios did not anticipate sufficient market penetration in the near-term to substantially change the modeling assumptions. Table 9.2-2 and Table 9.2-3 summarize capacity projections in MWe and total energy projections in GWh/year for renewable energy sources based on a seven percent renewable portfolio standard (RPS) and a 10 percent RPS. As part of the analyses discussed in Section 8.4, the modeling scenarios included consideration of renewables at the assumed RPS shown in Table 9.2-2 and Table 9.2-3.

The following subsections address potential renewable resources. The discussion for each potential renewable resource includes several considerations; including: (1) status of technology development, (2) capacity factors, (3) environmental issues, and (4) land use.

9.2.2.1.1 **Wind**

Figure 9.2-2 shows the annual average wind power in the United States. As shown on Figure 9.2-2, Michigan is a Class 2 wind power region. Figure 9.2-3 shows the wind power classification for the State of Michigan at 50 meters. As shown in Figure 9.2-3, the inland regions are considered relatively “Poor”; however, offshore wind classification ranges from “Good” to “Outstanding.” Michigan ranks 14th in terms of wind energy potential, but is currently well behind other states in terms of installed wind generating capacity. (Reference 9.2-3) There are three utility-scale wind turbines currently operating in Michigan – two in Mackinaw City and one in Traverse City, which together account for 2.4 megawatts of installed wind energy.

While wind technology is expected to improve in capacity factor and, of course, is attractive due to the renewable energy source characteristics, low capacity factors for wind generated power along with excessive cost of energy storage devices make this source unacceptable as an alternative to a baseloaded electricity generator. As shown in Table 9.2-1, wind capacity factors range from approximately 25 to 30 percent, well below the 90 to 95 percent required for a baseload plant (Reference 9.2-5). On average, wind resources would require 3.5 times as many MWe of installed capacity to provide an average capacity level equivalent to that from baseload nuclear resources with a capacity factor of 90 percent. However, even after adjusting for average available capacity, this capacity is not equivalent to that of a reliable baseload resource, given that in any point in time, generation can range from zero to full capacity. Furthermore, in general, there is a poor correlation between wind output and peak demand. In particular, wind tends to be unavailable on a hot summer day when both baseload and peaking resources are most needed.

Another key consideration is land use. In open, flat terrain, a utility-scale wind plant will require about 60 acres per megawatt of installed capacity. However, only five percent (three acres) or less of this area is actually occupied by turbines, access roads, and other equipment; 95 percent remains free for other compatible uses such as farming or ranching (Reference 9.2-6). Thus, for an equivalent 1600 MWe of electrical generation, at least 4800 acres is required. This does not factor in the reduced capacity factor for wind. Using the information that, on average, wind would require 3.5 times as many MWe installed capacity to provide an average capacity factor of 90 percent, the required land commitment increases to 16,800 acres.

As discussed above and shown on Figure 9.2-3, the greatest potential for electrical generation from wind are off-shore in the Great Lakes. As discussed in Reference 9.2-29, wind turbines up to 4.5 MWe each are available. Thus, for an equivalent 1600 MWe of electrical generation, approximately 350 wind turbines would be necessary. This does not factor in the reduced capacity factor for wind. Using the information that, on average, wind would require 3.5 times as many MWe installed capacity to provide an average capacity factor of 90 percent. In this event, up to approximately 1250 wind turbines would be necessary. There would also be impacts due to the additional transmission capability necessary to connect the wind turbines to the grid. The principal environmental impacts of such an installation would be those to aquatic ecological resources and possibly aesthetic impacts. Ecological impacts would occur during construction and could be managed by choice of construction methods (for example, avoiding particularly sensitive habitats). Aesthetic impacts would occur during operation of the wind installation and would depend on distance from the shore and orientation in regard to shoreline communities.

In summary, wind power is not a reasonable alternative to provide for the baseload need that would be served by Fermi 3 because of wind power’s lower capacity factor and land requirements.

9.2.2.1.2 **Solar Technologies: Photovoltaic Cells and Solar Thermal Power**

Consideration of solar technologies as an alternative to Fermi 3 must first focus on whether they can be built as baseload capacity. Due to their intermittent nature during the day and lack of economic thermal storage devices at night, solar is not considered a baseload replacement option compared to Fermi 3. Concentrated solar power and photovoltaic distributed generation generally are installed at the end-user location. As shown in Table 9.2-1, average capacity factors for solar range from 15 to 20 percent. Storage capacity is not commercially available to serve as baseload generation. As noted by EPRI (Reference 9.2-4), improved technology for energy storage is necessary to enable deployment of solar as a baseload source, and these advances are not predicted to be achieved in the near term.

Figure 9.2-4 shows the solar photovoltaic resource potential in the United States. As shown on Figure 9.2-4, the State of Michigan has a potential generation of 4 KW-hrs per square meter from photovoltaic. This is low compared with other regions of the United States where the potential is up to 6 to 7 KW-hrs per square meter.

Figure 9.2-5 shows the concentrated solar power resource potential in the United States. As shown on Figure 9.2-5, the State of Michigan has a potential generation of 3 to 4 KW-hrs per square meter. This is low compared with other regions of the United States where the potential is up to 7 to 8 KW-hrs per square meter.

Per Reference 9.2-2, it is estimated that 35,000 acres will be needed per 1000 MWe for photovoltaic and 14,000 acres per 1000 MWe for solar systems. This large amount of land use has potential adverse environmental effects such as:

- The land is lost to other uses
- The loss of wildlife habitat or agricultural lands
- The potential for erosion to develop without proper controls
- Substantial visual impacts created.

In summary, solar power is not a reasonable alternative to provide for the baseload need that would be served by Fermi 3 because of the relatively smaller potential for solar in the State of Michigan, solar power's lower capacity factor and high land requirements. This is also consistent with the conclusions in Reference 9.2-3.

9.2.2.1.3 **Hydropower**

Hydroelectric or hydropower has the ability to produce higher capacity factors than wind and solar. Table 9.2-1 indicates that hydroelectric has average capacity factors between approximately 30 and 40 percent. This is much less than the baseload requirement. Michigan has an estimated 613 megawatts total of developable hydroelectric resources (Reference 9.2-7). This is less than the output of Fermi 3.

Land use for a large-scale hydropower facility is estimated to be quite large. To provide 1000 MWe, a hydropower facility is estimated to require about 1,000,000 acres (Reference 9.2-2). Such facilities are difficult to site as a result of public concern over flooding, destruction of natural habitats, and alteration of natural river courses.

Because of the relatively low amount of undeveloped hydropower resources in Michigan and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 1600 MWe, it is concluded that hydropower is not a feasible alternative to Fermi 3.

9.2.2.1.4 **Geothermal**

As shown in Table 9.2-1, geothermal energy has an average capacity factor of approximately 75 to 80 percent. Other sources of information indicate that capacity factors for geothermal can reach 86 to 95 percent. Thus, where available, geothermal is suitable for use as a baseload power source.

However, geothermal energy is not widely used as baseload power generation because of the limited geographical availability of the resource and immature status of the technology (Reference 9.2-2). Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. As shown on Figure 9.2-6, the only geothermal resource potential in the State of Michigan is geothermal heat pumps. Geothermal heat pumps are used for space heating and cooling, as well as water heating; however, electricity generation is not possible with direct heat or geothermal heat pumps. No feasible eastern location for geothermal capacity can serve as an alternative to a baseload nuclear plant.

Therefore, a geothermal energy facility at or in the vicinity of Fermi 3 is not a viable alternative as a baseload plant.

9.2.2.1.5 **Biomass - Overall**

Figure 9.2-7 shows the potential resource for biomass fuels in the United States. This includes all types of biomass fuels. As shown on Figure 9.2-7, there are several areas of the United States that have greater potential biomass resources than the State of Michigan. Energy from biomass consists of energy from wood waste, municipal solid waste and landfill gas, and other biomass-derived fuels. These individual constituents are discussed in more detail below. Reference 9.2-8 summarizes the total biomass available in United States as a whole and in each state. Table 9.2-4 summarizes the information from Reference 9.2-8.

9.2.2.1.5.1 **Wood Waste**

As shown in Table 9.2-1, power generation from wood waste has an average capacity factor of approximately 70 to 75 percent. Thus, where available, wood waste can be used for baseload power generation.

Presently, wood waste burning projects are effectively limited to small-scale facilities because large-scale facilities are not economical. These developments are opportunistic and located near pulp, paper and paperboard industrial locations from which waste is available.

Additional development of wood waste generation is limited by the location and availability of wood waste resources. A report recently issued by the U.S. Department of Energy (DOE) and U.S. Department of Agriculture (USDA) (Reference 9.2-9) found that the amount of forestland-derived biomass that could be sustainably consumed nationally is approximately 368 million dry tons annually, which is more than 2.5 times the current national level. However the report cites accessibility of terrain, transportation costs, labor availability and needed equipment as major limiting factors in the expansion of biomass production.

Similar to coal-fired plants, wood waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment. Estimates in Reference 9.2-2 suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at smaller scales.

Reference 9.2-8 presents the current availability of biomass resources by state. For the State of Michigan, the total unused wood-derived biomass resource potential from forest residues, primary mill waste, secondary mill waste and urban wood is 2598 thousand tons. In order to provide a similar capacity to Fermi 3, approximately 8.6 million tons per year of biomass fuel would be needed.

As of 2005, approximately 159 MWe was produced in the State of Michigan using wood-fueled power plants. If Michigan's forest products industries were to rebound from recent plant closures and expand, the analysis suggests that there would be sufficient biomass resources, on a sustainable basis, to fuel roughly doubling Michigan's existing wood-fueled power plants using only the primary and secondary mill waste products. (Reference 9.2-3) This increase in this production would still be much less than the electricity produced by Fermi 3.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload power plant, the ecological impacts of large-scale timber cutting (for example soil erosion and loss of wildlife habitat), and high inefficiency, it is determined that wood waste is not a feasible alternative to Fermi 3.

9.2.2.1.5.2 **Municipal Solid Waste and Landfill Gas-Fired Facilities**

As shown in Table 9.2-1, municipal solid waste (MSW) and landfill gas-fired (LGF) capacity factors range from approximately 40 to 45 percent for MSW and 65 to 70 percent for LGF, well below the 90 to 95 percent required for a baseload plant. The State of Michigan considers LGF facilities as a renewable technology. The Chicago Climate Exchange considers certain LGF generation facilities to qualify as emission offset projects.

According to the EIA, in 2006, there were 3134 MWe of installed MSW and LGF projects throughout the United States, representing a six percent reduction from the 3330 MWe installed nationwide in 2002 (Reference 9.2-22). Site development of MSW projects is limited to landfill sites and is driven by waste management considerations, such as limited availability of sites for landfills due to permitting requirements and zoning restrictions.

An MSW facility has a footprint similar in size to that of a fossil fuel-fired generator, but also requires landfill space to deposit non-hazardous ash residue. Net overall landfill space is reduced as a result of the combustion process. A report by the National Renewable Energy Laboratory (NREL) (Reference 9.2-8) presents the current availability of methane from landfills by state. The annual potential amount of this resource is 446,000 tons in the State of Michigan. Given the dispersed nature of this energy source and the relatively small quantities, LGF facilities could only serve a small portion of an overall energy portfolio.

Due to low generation outputs, MSW and LGF are not reasonable alternatives to Fermi 3 as a potential baseload resource.

9.2.2.1.5.3 **Other Biomass-Derived Fuels**

In addition to wood and MSW fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). These are primarily agriculture-derived biomass. As shown in Table 9.2-1, average capacity factors for these other biomass-derived fuels are less than 65 percent, with the average for the years 2002–2006 of approximately 40 to 55 percent. These capacity factors are well below the 90 to 95 percent required for a baseload plant.

From Table 9.2-4, the current availability of agriculture-derived biomass resources in the State of Michigan (crop residues, methane from manure management and switchgrass) total approximately 5067 thousand-tons per year.

The 21st Century Electric Energy Plan indicates that, in practice, each MWe of wood-fueled electric power uses approximately 10,000 tons of wood residues per year. Michigan is estimated to have an additional 27.5 million dry tons of biomass available that, in theory, could fuel more than 2,750 MWe of generation each year. To account for competing land uses, high transportation costs for agricultural and forestry residues (effectively limiting the distance from resource lands to biomass generating facilities), and stiff global competition in the paper and forest products industries, a relatively high percentage of the theoretical potential generation is excluded in the plan studies.

Currently, the use of energy crops in the United States is primarily focused on producing ethanol for use in the transportation sector. Energy crops as feedstock for large-scale generation have not enjoyed the same attention or level of development. Subsection 8.3.8 of Reference 9.2-2 states that energy crop technology is uneconomical when compared with traditional sources of baseload generation. According to the United States Climate Change Technology Program (Reference 9.2-11), energy crop technology for generation is not expected to approach goal levels until 2020, mainly due to cost inefficiencies and a lack of commercial demonstration. Factors that may hinder growth in biomass resource include urbanization of farm lands, increased demand in the international meat and food grain markets, and soil erosion caused by harvesting of biomass resources.

Because of the lower efficiency of these plants (approximately 30 percent), the land use requirements are many times greater than the land required to support Fermi 3. On an energy equivalent basis, the acreage required to support 1000 MWe of baseload generation is approximately 500,000 acres (Reference 9.2-12). Subsection 8.3.8 of Reference 9.2-2 indicates that a crop-fired plant would have similar construction impacts and operational impacts as a wood-fueled plant.

Based on the above discussion and the current status of technological advances, it is determined that none of these technologies have progressed to the point of being competitive on a large scale or of being reliable enough to replace a large baseload plant. For these reasons, it is concluded that such fuels do not offer a feasible alternative to Fermi 3.

9.2.2.2 **Other Alternatives**

9.2.2.2.1 **Integrated Gasification Combined Cycle**

IGCC is an emerging, advanced technology that combines modern coal gasification technology with both gas turbine and steam turbine power generation. Compared to conventional pulverized coal-fired plants, the technology is substantially cleaner because major pollutants can be removed from the gas stream prior to combustion.

The IGCC process generates much less solid waste than the pulverized coal-fired alternative. The largest solid waste stream produced by IGCC installations is slag, a sand-like marketable by-product. Slag production is a function of the fuel ash content. The other large-volume by-product produced by IGCC plants is sulfur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC units do not produce ash or scrubber wastes.

Today's IGCC technology still needs operating experience for widespread expansion into commercial-scale, utility applications. Each major component of IGCC has been broadly utilized in industrial and power generation applications. However, the joining of coal gasification with a combined cycle power block to produce commercial electricity as a primary output is relatively new. This has been demonstrated at only a handful of facilities around the world, including five in the United States. Experience has been gained with the chemical processes of gasification and the impact of coal properties on the IGCC areas of design, efficiency, economics, etc. System reliability is still relatively low, as compared to nuclear plants. There are also problems with the process integration between gasification and power production.

An IGCC facility is not a reasonable alternative to Fermi 3, because IGCC technology currently is not cost-effective and requires further research to achieve an acceptable level of reliability.

9.2.2.2.2 **Fuel Cells**

Fuel cell technology offers a number of very attractive characteristics from an environmental impact standpoint in that they work without combustion and the associated environmental impacts. Power is produced electro-chemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. Higher temperature, second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations.

According to the EIA's Annual Energy Outlook in 2007 (Reference 9.2-1), fuel cells are not projected to provide any measurable source of electric generation through 2030. On a per-KW basis, the installed costs (EIA assumes that the installed cost of a 10 MWe fuel cell unit in 2006 is $4520/KW (Reference 9.2-13), plus variable operating plus maintenance costs for a fuel cell facility greatly exceed those of any other commercial-scale generating technology. The capital cost of advanced fuel cells is projected to remain uncompetitive with traditional sources of generation and the United States does not have an established hydrogen fuel supply structure. Hydrogen fuel is expensive and, like natural gas, from which it is derived, it has a volatile price history. Because of its high marginal cost, a fuel cell would most likely be used in periods of peak electricity demand. Moreover, because fuel cell technology has a short operating history, the lifespan of a fuel cell unit is uncertain.

For the preceding reasons, it is concluded that a fuel cell energy facility located at or in the vicinity of the Fermi site would not be a reasonable alternative to Fermi 3 for generation of baseload electricity.

9.2.2.3 **Non-Renewable Fuels**

9.2.2.3.1 **Oil-Fired Power Generation**

The EIA projects that, because of higher fuel costs and lower efficiencies, oil-fired plants will not provide new power generation capacity in the United States through the year 2030 (Reference 9.2-1). Oil-fired generation is more expensive than either the nuclear or coal-fired generation options. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has resulted in a decline in its use for electricity generation. In Subsection 8.3.11 of Reference 9.2-2, it is estimated that construction of a 1000 MWe oil-fired plant would require about 120 acres of land.

For the proceeding reasons, it is concluded that an oil-fired plant at the Fermi site would not be an economical alternative to construction of a 1600 MWe nuclear power generation facility, operated as a baseload plant.

9.2.2.3.2 **Coal-Fired Generation**

Pulverized coal-fired steam electric plants provide the majority of electric generating capacity in the United States, accounting for about 50 percent of the electricity generated and about 32 percent of summer electric generating capacity in 2005. Detroit Edison operates coal-fired power plants in the southeastern area of the State of Michigan; also referred to as the ITC*Transmission* service area. As discussed in Section 8.3, approximately 57 percent of the electrical generation in the ITC*Transmission* service area is from coal-fired generation. Furthermore, as discussed in Section 8.3, almost 50 percent of the active generation requests in the State of Michigan are for new coal-fired generation.

The environmental impacts of constructing a typical pulverized coal-fired power plant are well known. Conventional pulverized coal-fired boilers have been sized to take advantage of the economies of scale, at over 300 MWe. Both primary technologies for generating electrical energy from pulverized coal are considered: conventional pulverized coal boiler and fluidized bed combustion.

In conventional pulverized coal-fired power plants, pulverized coal is blown into a combustion chamber of a boiler and ignited. The released heat converts water in the boiler into steam. This high pressure steam is applied in a steam turbine to produce electricity. Flue gas is cleaned of significant fractions of major pollutants such as oxides of nitrogen (NOx), oxides of sulfur (SOx), and particulates.

Fluidized bed combustion (FBC) is an advanced electric power generation process. The FBC method is similar overall to conventional pulverized coal-fired boilers, but differs in the combustion process and content. FBC reduces the formation of gaseous pollutants by better controlling coal combustion parameters and by injecting a sorbent (such as crushed limestone) into the combustion chamber along with the fuel. Crushed fuel mixed with the sorbent is fluidized on jets of air in the combustion chamber. Sulfur released from the fuel as sulfur dioxide (SO_2) is captured by the sorbent in the bed to form a solid compound that is removed with the ash. The resultant by-product is a dry, benign solid that is potentially a marketable by-product for agricultural and construction applications. More than 90 percent of the sulfur in the fuel is captured in this process. NOx formation in FBC power plants is lower than that for conventional pulverized coal boilers because the operating temperature range is below the temperature at which thermal NOx is formed.

FBC power plants are currently limited to a maximum size of approximately 265 MWe. Although a multi-unit facility could be built, this would not be able to benefit from the economies of scale associated with a 1600 MWe project. Also, the lower operating temperature of the FBC system lowers efficiency levels as compared to conventional pulverized coal boilers. Due to the limited size of available units, and lower thermal efficiency, FBC is not a reasonable alternative to Fermi 3.

To improve the thermal efficiency of the FBC technology, a new type of FBC boiler is being proposed that encases the entire boiler inside a large pressure vessel. Burning coal in a pressurized fluidized bed combustion (PFBC) boiler results in a high-pressure stream of combustion gases that can spin a gas turbine to make electricity, then boil water for a steam turbine. It is estimated that efficiencies for PFBC systems would eventually exceed 50 percent. The PFBC technology is currently in the demonstration phase in most of the world and is not a feasible alternative for the proposed Fermi 3 project at this time. Barriers in commercial deployment opportunities of second-generation PFBC systems arise due to slow progress in hot gas filter development, high turbine costs, and complex plant integration. With the current state of technology development and projections for the future, it remains uncertain whether advanced PFBC systems can achieve the DOE goal of 20 to 25 percent reductions in electricity cost as well as capital cost reductions relative to current pulverized coal-fired power plants.

The United States has abundant low-cost coal reserves, and the price of coal for electric generation should increase at a relatively slow rate. Pulverized coal-fired power plants are likely to continue as a reliable energy source well into the future, assuming environmental constraints do not cause the gradual substitution of other fuels. Even with recent environmental regulation, new coal-fired capacity is expected to be an affordable technology for reliable, near-term development.

Based on the well-known technology, fuel availability, and generally understood environmental impacts associated with constructing and operating a coal-fired power plant, it is considered a reasonable alternative and is therefore evaluated further in Subsection 9.2.3.

9.2.2.3.3 **Natural Gas-Fired Generation**

Natural gas-fired generation using combined-cycle turbines is a technology that is available. In recent years, new electric generation in the State of Michigan has been limited to natural gas-fired power plants. As discussed in Chapter 8, natural gas-fired power plants represented approximately 10 percent of the State's generating capacity in 1992, but now represent approximately 29 percent of the generating capacity. These plants were built by independent power producers (IPPs). Many

IPPs have subsequently gone through bankruptcy as a rise in natural gas prices over the past several years made even the most efficient plants uneconomical to run for more than a few hours per year. Market prices driven by natural gas costs expose Michigan to volatile electricity prices. It is also noted that there are only limited interconnection requests for natural gas-fired generation in the active queue for the State of Michigan.

However, given that natural gas-fired generation is a well-known technology, has reasonable fuel availability, and environmental impacts associated with constructing and operating a natural gas-fired power plant are generally understood, it is considered a reasonable alternative to Fermi 3 and is therefore evaluated further in Subsection 9.2.3.

9.2.2.4 **Evaluation of Combinations of Alternatives**

This subsection considers whether combinations of alternatives could generate baseload power in an amount equivalent to Fermi 3. There are numerous possible combinations of power sources and the amount of output of each source. For the renewal of licenses pursuant to 10 CFR 54, the NRC has previously determined that expansive consideration of combinations would be too unwieldy given the purposes of the alternatives analysis (Reference 9.2-2).

The following analysis provides the basis for evaluating whether a combination of alternative energy sources is a viable option and, if so, whether it provides any different in environmental impacts with respect to evaluating possible alternative to Fermi 3. Subsection 9.2.2.4.1 evaluates whether any combination of renewables with non-renewable fuels is a viable and reasonable means of providing baseload power. Subsection 9.2.2.4.2 evaluates whether any combination of non-renewable fuels provides a different set of environmental impacts than individual non-renewable fuel facilities such that a separate analysis of the environmental impacts of the combination is necessary.

9.2.2.4.1 **Combinations of Alternatives Involving Renewable Fuels**

As discussed in Subsection 9.2.2.1, renewable resources are not of the scale or type to provide baseload power. Wind and solar are not feasible on their own to generate the equivalent baseload capacity or output of Fermi 3 because of the intermittent nature of the resources. As discussed below, no combination of renewable fuel and a non-renewable fuel facility is a viable alternative to provide baseload generation at the capacity of Fermi 3. In addition, as summarized in Section 8.4, the plan analysis concludes that renewables alone are not sufficient to meet projected electricity demands. For all scenarios examined, baseload generation from sources such as natural gas, coal and/or nuclear are required in addition to renewables and energy efficiency in order to meet the projected demands. In these cases, the use of renewables reduces the requirements for natural gas, coal and/or nuclear but it does not replace the requirements for these sources.

Wind and Non-Renewable Fuels

As discussed above wind power is considered by the industry as an intermittent, non-baseload generation resource. Accordingly, any combination of wind power with a non-renewable fuel facility would require not only that two facilities be built (the wind facility and the non-renewable fuel facility) with the concomitant construction impacts of each, but that based on wind power's lower capacity factor the reduction in emissions would conservatively be only approximately 25 to 30 percent. Accordingly, a combination of a wind power with non-renewable fuel facility is not a viable or reasonable alternative.

Photovoltaic Cells, Solar Thermal Power and Non-Renewable Fuels

A combination of photovoltaic cells, solar thermal power, and a non-renewable fuel facility would require, and have the impacts of, construction of two separate facilities. Also, like wind power, a conservative assumption for the effect of such a facility on the air emissions and solid waste associated with a non-renewable fuel facility would be an approximate reduction of 15 to 20 percent. Due to the low capacity factor for a solar resource, although the combination of solar and non-renewable fuels may be viable on a small-scale, it is not a reasonable alternative to the baseload that would be generated by Fermi 3.

Biomass, Wood Waste, Fuel Crops and Non-Renewable Fuels

A combination of biomass resources and non-renewable fuel facility would require, and have the impacts of, construction of several separate facilities. Given the relatively small scale of the biomass facilities, in order to compensate for a reasonable percentage of the non-renewable fuel source, several such facilities would be required. A combination of such facilities with a non-renewable fuel facility also has land impacts in the case of fuel crops. Therefore, due to the lower capacity output and high resource usage required, a combination of biomass, wood waste, fuel crops with a non-renewable fuel facility is not a viable or reasonable alternative.

MSW and Non-Renewable Fuels

As discussed in Subsection 9.2.2.1.5.2, MSW projects have historically maintained capacity factors of 40 to 45 percent. Site development of MSW projects is limited to landfill sites and is driven by waste management considerations. Due to permitting requirements and zoning restrictions, there are limited opportunities for such facilities. Therefore, a combination of MSW and non-renewable fuel alternative is not a viable or reasonable alternative.

9.2.2.4.2 **Combinations of Alternatives Involving Non-Renewable Fuels**

Any combination of coal-fired and natural gas-fired power plants would have the characteristics addressed in Subsection 9.2.3, below. In the analysis presented in Subsection 9.2.3, nether coal-fired or natural gas-fired generation is environmentally preferable to Fermi 3. Thus, it follows that, no combination of coal-fired and natural gas-fired generation will be environmentally preferable.

9.2.3 **Assessment of Competitive Alternative Energy Sources and Systems**

This subsection analyzes the possible alternative energy sources and systems and evaluates their ability to have an appreciable reduction in the overall environmental impact. Based on the evaluation in Subsection 9.2.2, above, the alternative energy sources evaluated in this subsection are coal-fired generation, natural gas-fired generation, and a combination of sources.

9.2.3.1 Coal-Fired Generation

In general, the environmental impacts of constructing a typical coal-fired power plant are well known because coal, as discussed earlier, is the most prevalent type of central generating technology in the United States. The impacts of constructing a large coal-fired power plant at a "greenfield" site can be substantial, particularly if it is sited in a rural area with considerable natural habitat (Reference 9.2-2).

9.2.3.1.1 Land Use and Related Impacts to Ecology

Since this alternative would involve new construction, one key environmental impact area is land use. In Reference 9.2-2 it is estimated that approximately 1700 acres would be needed for a 1000 MWe coal-fired power plant. This estimate would be scaled up for the approximately 1600 MWe capacity of the proposed coal-fired alternative (i.e., 2720 acres), which is considerably larger than that required for Fermi 3 (approximately 302 acres total, including permanent and temporary impacts). The Fermi site is approximately 1260 acres total, as noted in Section 2.2. Thus, the current site would not support a comparable sized coal-fired power plant.

Since large quantities of coal and lime (or limestone) would be delivered via rail line, new construction would be required to support railcar turnaround facilities. Given the substantial land use (relative to Fermi 3), the associated impacts related to land clearing, erosion and sedimentation, air quality from construction vehicles, impact to the ecology, etc., would be proportionally much greater for the coal-fired alternative.

In Reference 9.2-2, it is estimated that approximately 22,000 acres would be affected for mining the coal and disposing of the waste to support a 1000 MWe coal-fired power plant during its operational life. Thus, the equivalent land usage requirement for 1600 MWe coal-fired production would be approximately 35,200 acres. In contrast, based on estimates discussed in Reference 9.2-2, uranium mining and processing required to supply fuel during the operating life of a nuclear facility of 1600 MWe capacity would be approximately 1600 acres.

9.2.3.1.2 Waste Generation and Emissions

It is assumed that the new coal-fired power plants would primarily use western sub-bituminous coal – similar to the current fleet of Detroit Edison coal-fired power plants. It is estimated that the proposed power plant would consume approximately 7 million tons/yr of pulverized sub-bituminous coal with corresponding ash content (determined from information in Reference 9.2-14 for Detroit Edison historical coal usage versus power generation). Lime or limestone, used in the scrubbing process for control of sulfur dioxide emissions, is injected as a slurry into the hot effluent combustion gases to remove entrained sulfur dioxide. The lime-based scrubbing solution reacts with sulfur dioxide to form calcium sulfite, which precipitates and is removed from the process as sludge.

As discussed in Reference 9.2-27, coal combustion products (CCP) are among material targeted by the U.S. Environmental Protection Agency (EPA) Resource Conservation Challenge (RCC). The RCC is designed to facilitate changes in the economics and practice of waste generation, handling, and disposal (e.g., by promoting market opportunities for beneficial use). Currently, the most common beneficial uses for CCPs are as a replacement for virgin materials in concrete and cement making, structural fill and gypsum wallboard. Reference 9.2-27 summarizes results from the most recent survey of generators of CCPs. These results show the application uses for the CCPs along with the total utilization rate for each of the CCPs. For example, the utilization rate for gypsum from the flue gas desulphurization (FGD) process accounts is approximately 77 percent, the majority of the use of FGD gypsum is as a substitute for virgin gypsum in wallboard manufacturing. The total CCP utilization rate for all CCPs combined is 40 percent. The EPA goals discussed in Reference 9.2-27 include achieving an overall 50 percent beneficial use of CCPs by 2011.

Even with current recycling levels and the EPA goals for increasing the recycling levels, there is still a considerable amount of waste products for disposal. Waste impacts to groundwater and surface-water could extend beyond the operating life of the power plant if leachate and runoff from the waste storage area occurs (Reference 9.2-14).

9.2.3.1.3 **Air Quality and Human Health**

Dust emissions from construction activities for a coal-fired power plant would be similar to those from any similar construction project. Such emissions would be temporary, mitigated using best management practices, and therefore SMALL.

During its operating life, the emissions profile regarding air quality from coal-fired generation will vary significantly from that of a nuclear power generation because of emissions of sulfur oxides, nitrogen oxides, carbon monoxide, particulates, and other constituents. A coal-fired power plant would also have unregulated carbon dioxide emissions that many scientists believe contribute to global warming. The assumed plant design would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Estimates for the coal-fired alternative emissions for particulate matter (PM), nitrogen oxides (NOx), sulfur oxides (SOx), carbon dioxide (CO_2), and mercury are as follows (Table 9.2-5):

- PM – 48 tons per year.
- NOx – 1,330 tons per year
- SOx – 2,260 tons per year
- CO_2 – 17,750,000 tons per year
- Mercury – 0.1 tons per year

The acid rain requirements of the Clean Air Act (42 U.S.C. 7491) capped the nation's sulfur dioxide emissions from power plants. An operator would have to obtain sufficient pollution credits either from a set-aside pool or purchases on the open market to cover annual emissions from the plant. The market based allowance system used for sulfur dioxide emissions is not used for NOx emissions. A new coal-fired power plant would be subject to the new source performance standard for such plants (40 CFR 60.44a(d)(1)), which limits the discharge of any gases that contain NOx (expressed as nitrogen dioxide).

It is further noted that coal-fired power plants are expected to be subject to some form of additional cost related to carbon dioxide. As discussed in Reference 9.2-3:

> The urgent problem of global climate change is expected to be addressed at the federal level within the next five years. While there are no known state proposals to tax carbon dioxide, discussion at the federal level is heating up, and it would be imprudent not to consider that such a tax, or other greenhouse gas controls, could emerge in the near future.

As further noted, carbon dioxide emissions regulation could substantially raise the cost of electricity produced by conventional coal. In addition to the expected federal actions, the State of Michigan is also considering implementing actions to reduce emissions. By order of the Governor of the State of Michigan, the Michigan Climate Action Council (MCAC) was established as an advisory board to the Michigan Department of Environmental Quality (MDEQ). Reference 9.2-28 provides an interim report providing short-term, mid-term, and long-term emissions reduction goals for Michigan.

A new coal-fired power plant in southern Michigan would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants in 40 CFR 60 Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (40 CFR 60.43a), and nitrogen oxide (40 CFR 60.44a).

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including specific requirements for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants under the Clean Air Act (40 CFR 51.307(a)) and areas designated as nonattainment under the Clean Air Act (40 CFR 51.307(b)). The majority of Michigan has been classified as attainment or unclassified for criteria pollutants (40 CFR 81.323). Maintenance areas for the 8-hour ozone standard include Monroe County and seven other counties in the Detroit-Ann Arbor area. Nonattainment areas for $PM_{2.5}$ include Monroe and six other counties in the Detroit-Ann Arbor area.

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that, for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new coal-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Isle Royale National Park and Seney National Wildlife Refuge are Class I areas in the State of Michigan where visibility is an important value (40 CFR 81.414). Both of these areas are located in the Upper Peninsula of Michigan. Air quality in these areas would not likely be affected by a coal-fired power plant at an alternate site in southern Michigan in the vicinity of the Fermi site. In addition, there are no Class I areas in the State of Ohio. (Reference 9.2-17)

Reference 9.2-2 did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. Reference 9.2-2 also mentioned global warming from unregulated carbon dioxide emissions and acid rain from sulfur oxides and nitrogen oxide emissions as a potential impact. Adverse human health effects, such as cancer and emphysema, have been associated with the products of coal combustion.

Overall, it is concluded that air quality impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

9.2.3.1.4 **Cooling System Considerations, Water Use, and Related Impacts to Ecology**

The NRC evaluated the coal-fired power plant with both open and closed cycle cooling systems (Reference 9.2-2). In general, in either case, intake and discharge would be designed to comply with state and federal standards. As discussed in Reference 9.2-2, the closed-cycle system would require slightly more land, but the difference is insignificant relative to the overall land use requirement noted above. The open-cycle system, with a higher intake and discharge flow rate, could have greater potential impacts, e.g., impingement and entrainment of fish and thermal impacts, to the aquatic ecosystem. The closed-cycle system would typically rely on large natural draft cooling towers or mechanical fan-cooled cooling towers. The trade-off in this case would be the evaporation, drift, and other impacts from the cooling tower, including discharge of dissolved solids to Lake Erie of cooling tower blowdown. The decreased intake flow rate of the closed-cycle system would have less impact on the aquatic ecosystem (e.g., impingement and entrainment mortalities) and less thermal impact on the receiving water body. Water use impacts depend on the volume of water required and the characteristics of the receiving body.

Similar to Fermi 3, the bulk of the coal-fired power plant’s raw water makeup is assumed to come from Lake Erie. As shown on Figure 2.1-4, a new cooling system intake structure on the lake would be required, resulting in temporary impact during construction. However, as evaluated for Fermi 3 in Chapter 4 and Chapter 5, neither the construction nor operation of the coal-fired power plant’s intake would be expected to have a significant impact on surface-water. The coal-fired power plant’s discharge to the lake would be expected to have impacts comparable to those of Fermi 3, i.e., not significant.

If the coal-fired power plant were placed on an alternate site, there could be impacts depending on available surface-water and groundwater sources. In any case, appropriate permits would govern and limit surface-water and groundwater use and impacts. Overall, the impacts are expected to be SMALL.

9.2.3.1.5 **Socioeconomics**

The coal-fired power plant would require an estimated construction work force of 2500 workers over a five year period. Thus, surrounding communities would experience demands for housing and public services. And following the conclusion of construction, the communities would then experience the loss of some portion of these construction jobs. With this workforce, area roads would experience increased traffic loads to and from the construction site (Reference 9.2-2). Fermi 3 expects a construction workforce of 2900 over a comparable five to six year period.

With the slightly smaller construction workforce (2500 vs. 2900), socioeconomic impacts could be expected to be slightly smaller in comparison to Fermi 3. As was the case in the construction of Fermi 2, these impacts related to the workforce would likely be dispersed over a relatively large geographic area that includes the southern suburbs of Detroit. While the commuting workforce would come from communities surrounding the construction site, many would likely originate from Detroit and Ann Arbor suburban area due to services available there. Based on an assessment of current highway capacities around the Fermi site and considering reasonable assumptions regarding carpooling and management of shift changes (Subsection 4.4.2), there would be little overall difference in impacts between the coal-fired alternative and Fermi 3.

Providing some offset to these impacts would be benefits related to construction and operation. In the short term, during construction, some portion of surrounding communities could be expected to find employment in construction jobs at the site. In the long term, the tax base would increase for affected communities. Both of these benefits would be proportionally larger for Fermi 3. Thus, while the Fermi 3 workforce is greater than that of the coal-fired power plant, the impacts will be short term and mitigated by dispersion over several relatively populous counties and improved transportation routes. Impacts would be offset, to some degree, by a proportionally larger employment opportunity and tax base associated with Fermi 3.

Fermi 3 was evaluated to have no significant adverse environmental or human health impacts; therefore, no potential disproportionate impacts to low income and/or minority groups are expected. See the review of environmental justice in Section 4.4 and Section 5.8 for additional detail. These conclusions would be unchanged for a coal-fired power plant.

9.2.3.1.6 Transportation and Fuel Cycle Impacts of a Project Compared to the Coal-Fired Alternative

Table S-3 of 10 CFR 51.51 summarizes environmental impact data associated with the uranium fuel cycle. Section 5.7 demonstrates the applicability of the Table S-3 environmental and human health effects for Fermi 3.

The environmental impacts associated with transporting fresh fuel to and spent fuel and waste from a 1000 MWe light water reactor (LWR) are summarized in Table S-4 of 10 CFR 51.52. Section 3.8 demonstrates that the environmental impacts of transportation of fuel and radioactive wastes for Fermi 3 SMALL.

Both Table S-3 and S-4 compilations are based on reference LWR reactors with a specific MWe output. Therefore, the environmental impacts are scaled appropriately to estimate impacts associated with the target site capacity of 1600 MWe of Fermi 3. However, in general, given the assessments of Fermi 3 provided in Section 3.8 and Section 5.7, it can be concluded that the expected impacts associated with the uranium fuel cycle and transportation of nuclear fuels for Fermi 3 would be consistent with that compiled by the NRC in Tables S-3 and S-4. Thus, given the assessments in Section 3.8 and Section 5.7 and in consideration of the above discussion of coal-fired power plant waste generation, impacts to air quality, and human health, the coal-fired power plant would not be expected to be an environmentally preferable alternative.

9.2.3.1.7 **Coal-Fired Generation Conclusion**

In conclusion, as discussed above, coal-fired generation is not expected to be an environmentally preferable alternative. This conclusion is based on significantly increased air emissions and land usage requirements.

9.2.3.2 **Natural Gas-Fired Generation**

The environmental impacts of the natural gas-fired alternative are examined in this subsection, considering both the Fermi site and an unnamed alternate site. The analysis assumes a closed-cycle cooling system since the once-through system is considered to have greater overall environmental impacts (for reasons discussed in the preceding analysis of the coal-fired alternative).

9.2.3.2.1 **Land Use and Related Impacts to Ecology**

As reported in Subsection 2.2.1.2.7, the closest natural gas pipeline is approximately 10 miles west of the Fermi site. Thus, for the case in which the natural gas-fired power plant is built at (or near) the Fermi site, there would be an associated considerable impact related to pipeline construction. For the purposes of this assessment, without performing more detailed evaluations of pipeline capacity, it is assumed that the capacity of this closest pipeline would be sufficient. This provides a conservative assessment as this assumption minimizes the potential land use and ecological impacts.

In Reference 9.2-2, it is estimated that approximately 110 acres would be needed for a 1000 MWe natural gas-fired power plant. This estimate would be scaled up for the approximately 1600 MWe capacity of the natural gas-fired alternative, resulting in 176 acres. The natural gas-fired power plant likely could be sited on the Fermi site on land that was previously disturbed in the construction of Fermi 1 and 2 and on land previously not disturbed. From Reference 9.2-18, approximately 100 acres would be impacted by a new five mile gas pipeline. Thus, the 10 miles of new pipeline need to locate a natural gas-fired power plant at the Fermi site would impact an additional 200 acres. Thus, the total land use commitment (for siting the natural gas-fired power plant at the Fermi site) would be approximately 376 acres.

Fermi 3 is expected to require approximately 155 acres. Thus, the natural gas-fired power plant’s footprint (if sited at the Fermi site) is larger than the Fermi 3 land use (176 acres vs. 155 acres). This does not include land impacted by transmission changes. Impacts to transmission will be similar for either the natural gas-fired power plant or Fermi 3. As the land permanently impacted for either a natural gas-fired power plant or the proposed project is approximately equivalent, the impacts to wildlife would also be approximately equivalent. Therefore, in sum from this perspective, the natural gas-fired power plant would not be considered environmentally preferable to Fermi 3.

In addition to the use of 155 acres for permanent structures for Fermi 3, up to approximately 147 additional acres could be affected (temporarily) during construction of Fermi 3. Land used temporarily during construction would be subject to standard mitigation procedures to minimize impact. Appropriate measures would also be taken to restore the land, and long-term impact is not expected. Temporary land use during construction of the natural gas-fired power plant was not available. The estimated total natural gas-fired power plant operational footprint (176acres) is larger than that of Fermi 3. In addition, accounting for the land temporarily affected by installation of the new gas pipeline, the total land affected is even greater for a natural gas-fired power plant. The natural gas-fired power plant construction and operational impact could be larger if placed at another site requiring additional gas supply pipeline right-of-way and construction. Without specific data on land temporarily impacted during natural gas-fired power plant construction, further assessment is not possible. However, it can be assumed that even with the use of standard mitigation procedures and the temporary nature of these impacts, it is not likely that construction land use and the associated impacts to ecology would make the natural gas-fired power plant environmentally preferable to Fermi 3.

Additional land could be required for natural gas wells and additional infrastructure to support gas processing, treatment, regulations and metering. Based on estimates in Reference 9.2-2, approximately 5760 acres would be required to support a natural gas-fired power plant of approximately 1600 MWe. Uranium mining and processing could require approximately 1600 acres for the operating life of a nuclear facility of 1600 MWe capacity. Given this consideration and the relatively larger land use related to fuel source (and the related impacts to the ecology), the natural gas-fired alternative would not be environmentally preferable to Fermi 3.

9.2.3.2.2 **Air Quality**

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired power plant, a natural gas-fired power plant would release similar types of emissions but in lower quantities.

A new natural gas-fired power plant in southern Michigan would likely need a prevention of significant deterioration permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants in 40 CFR 60 Subpart Da. The standards establish emission limits for particulate matter and opacity (40 CFR 60.42a), sulfur dioxide (40 CFR 60.43a), and nitrogen oxide (40 CFR 60.44a).

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including specific requirements for review of any new major stationary source in an area designated as attainment or unclassified for criteria pollutants under the Clean Air Act (40 CFR 51.307(a)) and areas designated as nonattainment under the Clean Air Act (40 CFR 51.307(b)). The majority of Michigan has been classified as attainment or unclassified for criteria pollutants (40 CFR 81.323). Maintenance areas for the 8-hour ozone standard include Monroe County and seven other counties in the Detroit-Ann Arbor area. Nonattainment areas for $PM_{2.5}$ include Monroe and six other counties in the Detroit-Ann Arbor area.

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment occurs because of air pollution resulting from human activities. In addition, EPA regulations provide that, for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for those days on which visibility is most impaired over the period of the implementation plan and ensure no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). If a new natural gas-fired power plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. Isle Royale National Park and Seney National Wildlife Refuge are Class I areas in the State of Michigan where visibility is an important value (40 CFR 81.414). Both of these areas are located in the Upper Peninsula of Michigan. Air quality in these areas would not likely be affected by a natural gas-fired power plant at an alternate site in southern Michigan in the vicinity of the Fermi site. In addition, there are no Class I areas in the State of Ohio. (Reference 9.2-17)

During its operating life, the emissions profile regarding air quality from natural gas-fired generation will vary significantly from that of a nuclear power generation because of emissions of sulfur oxides, nitrogen oxides, carbon monoxide, particulates, and other constituents. A natural gas-fired power plant would also have unregulated carbon dioxide emissions that many scientists believe contribute to global warming. The assumed plant design would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. The estimated emissions for the natural gas-fired power plant for particulate matter (PM), nitrogen oxides (NOx), sulfur oxides (SOx), carbon monoxide (CO), and carbon dioxide (CO_2) are as follows (Table 9.2-6):

- PM – 290 tons per year.
- NOx – 3800 tons per year
- SOx – 41 tons per year
- CO – 1600 tons per year
- CO_2 – 4,800,000 tons per year

The combustion turbine portion of the combined-cycle power plant would be subject to the EPA's National Emission Standards for Hazardous Air Pollutants for Stationary Combustion Turbines (40 CFR 63, Subpart YYYY) if the site is a major source of hazardous air pollutants. Major sources have the potential to emit 10 tons/yr or more of any single hazardous air pollutant or 25 tons/yr or more of any combination of hazardous air pollutants (40 CFR 63.6085(b)).

The fugitive dust emissions from construction activities would be mitigated using best management practices; such emissions would be temporary.

The impacts of emissions from a natural gas-fired power plant would be clearly noticeable, but would not be sufficient to destabilize air resources. Overall, the air quality impacts resulting from construction and operation from new natural gas-fired power plant at the Fermi site would be SMALL to MODERATE.

9.2.3.2.3 **Cooling System Considerations, Water Use, and Related Impacts to Ecology**

The natural gas-fired power plant is assumed to use a closed-cycle cooling system with the bulk of raw water makeup to come from Lake Erie (for siting at the Fermi site). A new cooling system intake structure on the river would be required, resulting in temporary impact during construction. However, as evaluated for Fermi 3 (Chapter 4 and Chapter 5), neither the construction nor operation of the natural gas-fired power plant's intake would be expected to have a significant impact on surface-water. The natural gas-fired power plant's discharge to the lake would be expected to have impacts comparable to those of Fermi 3, i.e., not significant.

If the natural gas-fired power plant were placed on an alternate site, there could be other impacts, depending on available surface-water and groundwater resources. In any case, appropriate permits would govern and limit surface-water and groundwater use and impacts. Overall, the impacts are expected to be SMALL.

9.2.3.2.4 **Human Health**

In Reference 9.2-2, cancer and emphysema are identified as potential health risks from natural gas-fired power plants. The risk may be attributable to NOx emissions that contribute to ozone formation, which in turn contribute to health risk. Air emissions from a natural gas-fired power plant located at the Fermi site would be regulated by the MDEQ.

The human health effect is expected to be either undetectable or sufficiently minor. Overall, the impacts on human health from natural gas-fired power plant would be SMALL.

9.2.3.2.5 **Socioeconomics**

Reference 9.2-2 concluded that the construction workforce and local and state tax revenue would be smaller than a coal-fired power plant. Additionally, the construction period would be shorter than either coal or nuclear. Reference 9.2-2 estimates that the full-time workforce would be approximately 150 for a 1500 MWe power plant, the lowest of any technology. Socioeconomic impacts would result from the workforce needed to operate the natural gas-fired power plant, as well as local tax revenues from the facility. The workforce to construct a natural gas-fired power plant would also be smaller.

Socioeconomic impact would be of a similar nature to that described above for the coal-fired alternative except that the estimated natural gas-fired power plant construction and operational work force is smaller, along with a shorter projected construction period. With the smaller construction workforce and shorter construction period, socioeconomic impacts are expected to be smaller in comparison to the larger scale construction effort predicted for Fermi 3. However, as discussed above regarding the coal-fired alternative, these impacts are expected to be distributed over a relatively large geographic area and mature population centers. In addition, key transportation routes have been or are being improved which would help mitigate impacts of higher construction traffic loads. Road capacities are considered to be adequate to support the larger construction workforce assumed for Fermi 3; thus, on net, the differences regarding transportation impact between the natural gas-fired alternative and Fermi 3 are not expected to be significant.

These socioeconomic impacts (in general) are short-term, during construction. Providing some degree of offset to these impacts are benefits related to an increase in job opportunities during construction (short term) and an increased tax base (long term). Thus, while the Fermi 3 workforce and construction time period are greater than that of the natural gas-fired power plant, the impacts will be short term and mitigated by dispersion over several relatively populous counties and improved transportation routes. Impacts would be offset, to some degree, by a proportionally larger employment opportunity and tax base associated with Fermi 3.

Fermi 3 was evaluated to have no significant adverse environmental or human health impacts; therefore, no potential disproportionate impacts to low income and/or minority groups are expected. Refer to the review of environmental justice in Subsection 4.4.3 and Subsection 5.8.3 for additional detail. These conclusions would be unchanged for a natural gas-fired power plant.

9.2.3.2.6 **Air Quality, Human Health, and Other Fuel Cycle Impacts of a Project Compared to the Natural Gas-fired Alternative**

Section 3.8 and Section 5.7 provide assessments of the nuclear fuels transportation and fuel cycle impacts associated with Fermi 3. Given the assessments of Section 3.8 and Section 5.7 and considering the above discussion of the impact to air quality and human health for the natural gas-fired power plant, the natural gas-fired power plant would not be expected to be an environmentally preferable alternative.

9.2.3.2.7 **Natural Gas-Fired Generation Conclusion**

In conclusion, as discussed above, natural gas-fired generation would not be expected to be an environmentally preferable alternative. This conclusion is based on increased air emissions and land usage requirements.

9.2.3.3 **Combination of Power Purchase, Plant Reactivation or Extended Service Life, or Demand-Side Management**

Individual alternatives to the construction of a new nuclear facility at the Fermi site might not be sufficient on their own to generate the target value of 1600 MWe because of the small size of the resource or lack of cost effective opportunities. Nevertheless, it is conceivable that a combination of alternatives might be cost effective. There are many possible combinations of alternatives.

For reasons already discussed in Subsection 9.2.1, alternatives involving purchased power and reactivation or extended service life of generators are not expected to be environmentally preferable (based on relative environmental impacts) and/or reasonable alternatives (due to market demand considerations). Conservation measures could provide a partial offset of the need for power that would be supplied by Fermi 3. The remaining portion of the proposed capacity would have to be supplied by one or both of the remaining viable alternatives.

Section 8.4 summarizes the analysis performed as part of the 21st Century Electric Energy Plan. As part of the integrated resource planning, several different scenarios were considered.

- Scenarios Considered:
    - Central Station Generation
    - Emissions (carbon dioxide controls)

- Energy Efficiency
- Renewable Energy
- Energy Efficiency with Renewable Energy
- Combustion Turbines Only

To provide for a robust evaluation, several different sensitivities were considered for each of the above scenarios.

- Sensitivities Considered:
  - High Demand Growth
  - Low Demand Growth
  - Expanded Transmission Capability
  - Low Transmission Capability
  - Low Energy Efficiency Penetration

The scenarios and sensitivities are discussed in more detail in Section 8.4 and the 21st Century Electric Energy Plan. To summarize, for the Emissions Scenario, the nuclear option is included in the resource optimization. The major difference that emerged from the Emissions Scenario was the added cost associated with emission allowances. As shown above, several sensitivities were included for the Emissions Scenario (High Load Growth, Low Load Growth and Energy Efficiency). For the Base Emissions Scenario, and for each of the associated sensitivities, including nuclear units as part of the resource optimization due to the levelized cost is preferable to other technologies.

As part of the Detroit Edison Integrated Resource Plan (Reference 9.2-20) several scenarios and sensitivities, similar to the 21st Century Electric Energy Plan, were considered:

- High and low load sensitivities
- Low and high gas price sensitivities
- Restricted and expanded transmission import scenarios
- Low reserve margin scenario
- Varying Renewable Portfolio Standard sensitivities
- Nuclear production tax credit scenario
- Varying Carbon Dioxide Tax sensitivities

The results of these scenarios and sensitivities clearly demonstrated that in all cases where a modest carbon dioxide tax was assumed, nuclear was selected over coal-fired by a wide margin as the baseload technology of choice. In the cases where no carbon dioxide cost was assumed, coal-fired was selected over nuclear by a relatively small margin. In the Integrated Resource Plan, Detroit Edison assumes that some form of carbon dioxide cost (Base Case assumed $10/ton) is likely within the next 10 years. This assumption is based on numerous issues and activities in recent years, including (1) several bills that have been introduced into the U.S. Congress addressing global climate change and greenhouse gas emissions, (2) legislation passed in several States to control emissions, and (3) the carbon dioxide exchange trading system for plant emissions adopted by the European Union. Given this assumption, the robustness of the nuclear baseload selection is further evidenced by the fact that, in the analyses, a significant increase in nuclear capital cost was required before a baseload coal-fired option was selected over nuclear.

As discussed above, coal-fired and natural gas-fired are not preferred alternatives to Fermi 3 from an environmental perspective. Therefore, based on the plan evaluations, combination of alternatives considered herein are not a preferably alternative to Fermi 3.

9.2.4 Conclusion

The preceding alternatives analysis utilized the following intentional, structured methodology:

1. Initially, alternatives not requiring new generating capacity are considered are in Subsection 9.2.1. This includes consideration of power purchases, plant re-activation or extending service life of existing facilities, and demand-side management measures such as conservation, efficiency and demand management programs. Subsection 9.2.1 concludes that these measures, alone, are not sufficient to mitigate the requirements for the need for new baseload generation.
2. The next step was to evaluate possible means of meeting the generation need. This includes consideration of renewable, non-renewable and other technologies. As part of this evaluation in Subsection 9.2.2, a wide variety of potential alternative energy sources were considered. The evaluation in Subsection 9.2.2 is essentially a screening process to identify potential sources that should be considered for more detailed evaluation. The majority of the sources considered in Subsection 9.2.2 were eliminated due to high land use impacts, low capacity factors, geographic availability of the resource, or the emergent, unproven nature of the technology. Potential sources of meeting the identified need for generation that passed the screening in Subsection 9.2.2 were further evaluated in Subsection 9.2.3. Subsection 9.2.2 concludes that only coal-fired and natural gas-fired generation provide reasonable alternatives to Fermi 3 for meeting the identified need for new baseload generation.
3. Subsection 9.2.3 provides the further evaluation of potential sources that passed through the screening evaluation in Subsection 9.2.2. For the identified technologies, key environmental impact areas were identified, and the viable, competitive alternatives were analyzed to determine if any of the alternatives could be considered environmentally preferable to Fermi 3. The results of the evaluation in Subsection 9.2.3 are summarized in Table 9.2-7.

The overall conclusions from the above evaluation methodology are summarized below:

1. Permanent land use for the generating facility (Fermi 3 or otherwise) represents unavoidable environmental impacts. None of the viable, competitive alternatives were

identified to provide an appreciable reduction in overall impact. In addition, Fermi 3 was estimated to require less land use commitment for obtaining the fuel source (by mining or wells, depending on the source). The coal-fired and natural gas-fired alternatives were substantially inferior due to relatively large construction and operational land use requirements.

2. Ecological impacts can vary depending on whether or not the alternative plants are sited at Fermi site or an alternate site. As in the assessment of land use, none of the viable competitive alternatives were found to provide an appreciable reduction in overall impact to the ecology. In addition, these alternatives were expected to have greater impacts to the ecology due to fuel source-related land use. No environmentally preferable alternatives were identified.
3. Closed-cycle cooling systems were considered for the alternatives (as is intended for Fermi 3). In evaluating surface and ground water impact, no environmentally preferable alternatives were identified.
4. Air quality impacts are largely related to airborne emissions. Fermi 3 was expected to provide the lowest amount of key contaminants into the atmosphere. The coal-fired alternative, with substantially greater emissions, was considered environmental inferior for this impact area. No environmentally preferable alternatives were identified.
5. Impacts related to waste generation, transportation, and human health were assessed. No environmentally preferable alternatives were identified.
6. Socioeconomic impacts related to coal-fired and natural gas-fired alternatives were considered, relative to that of Fermi 3. Construction work force and duration are key parameters. While Fermi 3 is estimated to have a larger work force and longer construction duration (in comparison to the natural gas-fired alternative), the associated increased socioeconomic impacts are temporary (during construction) and are expected to be mitigated by the distribution of these impacts over a larger, more populous area and by improved transportation routes. These impacts could be offset to some degree by the opportunity for increased employment during construction. In the long term, surrounding communities could also benefit from a relatively higher tax base. Environmental justice was considered in this analysis. Fermi 3 has no significant adverse environmental or human health impacts; therefore, no disproportionate impacts to special population groups are expected. No environmentally preferable alternatives were identified.

This analysis concludes that, for the key environmental impact areas evaluated, there is no alternative energy source identified as environmentally preferable to Fermi 3.

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Table 9.2-1 Average Capacity Factors for Renewable Resources

	Capacity Factor By Sector (%)				
Sector/Source	**2002**	**2003**	**2004**	**2005**	**2006**
Biomass	63.6%	63.2%	62.4%	63.1%	64.0%
Waste	45.2%	48.0%	50.1%	49.0%	49.8%
Landfill Gas	64.8%	67.2%	68.2%	66.1%	66.5%
MSW Biogenic[1]	39.6%	38.8%	42.4%	43.9%	45.1%
Other Biomass[2]	40.0%	61.2%	53.4%	41.4%	39.9%
Wood and Derived Fuels[3]	75.5%	73.0%	69.4%	71.3%	72.5%
Geothermal	73.5%	77.2%	78.6%	73.4%	73.3%
Hydroelectric Conventional	38.0%	40.0%	39.5%	39.8%	42.4%
Solar/ PV	16.0%	15.4%	16.5%	15.3%	14.0%
Wind	26.8%	21.3%	25.0%	23.4%	26.5%

1. Includes total capacity whose primary energy source is MSW.
2. Agriculture by-products/crops, sludge waste, tires, and other biomass solids, liquids and gases. Does not include tires.
3. Black liquor, wood/wood waste solids and liquids.

MSW=Municipal Solid Waste.
Data for 2006 is preliminary

Reference 9.2-21 and Reference 9.2-22 (capacity factor was determined using the following formula:
Capacity Factor = Annual Generation (MWe-hr)/(Annual Net Summer capacity * 24 hours * 365 Days)

Table 9.2-2 State of Michigan Capacity Projections from Renewables for 7 and 10 Percent Renewable Portfolios (MWe)

	Modeled 7% RPS					Accelerated 10% RPS	
Year	Landfill Gas	Anaerobic Digestion	Cellulosic Biomass	Wind	Total	Wind	Total[1]
2006	0	0	0	0	0	0	0
2007	24	4	0	10	38	239	267
2008	47	11	41	87	185	478	577
2009	71	18	81	88	258	609	779
2010	94	24	122	119	358	956	1196
2011	118	30	162	154	464	1194	1504
2012	120	43	207	272	642	1433	1803
2013	123	53	251	360	787	1672	2099
2014	126	64	296	410	896	1911	2397
2015	128	73	340	465	1006	2150	2691
2016	131	82	385	525	1123	2150[2]	2748
2017	134	83	392	535	1144	2150	2759
2018	136	85	401	546	1168	2150	2772
2019	139	87	410	559	1194	2150	2786
2020	142	89	419	571	1221	2225	2875
2021	145	91	428	583	1246	2225[2]	2889
2022	147	93	437	595	1271	2300	2977
2023	150	95	446	609	1299	2300[2]	2991
2024	153	97	456	622	1328	2375	3081
2025	155	99	465	634	1354	2375[2]	3094

Notes:
1. Landfill gas, anaerobic digestion and cellulosic biomass quantities are unchanged for the accelerated RPS.
2. Wind capacity remains the same some years after 2015 because biomass resource types were all projected to continue to increase from 2016 through 2025 at the same rate as forecast demand. In order to maintain the RPS as close as possible to a constant 10%, wind capacity growth was modeled at 75 MWe increments every few years.

Source: Reference 9.2-3

Table 9.2-3 Energy Projections for 7 and 10 Percent Renewable Portfolios (GWh/year and Percent of Total Generation Requirements)

			Modeled 7% RPS						Accelerated 10% RPS		
Year	21st Century Plan Forecast	Existing Renewable	Landfill Gas	Anaerobic Digestion	Cellulosic Biomass	Wind	Total New Renewable	RPS (%)	Wind	Total[1] New Renewable	RPS (%)
2006	112,183	3279	0	0	0	0	0	2.9%	0	0	2.9%
2007	113,021	3279	189	28	0	25	242	3.1%	586	803	3.6%
2008	114,492	3279	370	74	284	213	942	3.7%	1172	1900	4.5%
2009	115,411	3279	560	123	568	216	1467	4.1%	1494	2745	5.2%
2010	116,902	3279	741	165	853	292	2051	4.6%	2344	4103	6.3%
2011	118,442	3279	930	207	1135	378	2650	5.0%	2930	5202	7.2%
2012	120,245	3279	946	304	1448	667	3365	5.5%	3516	6214	7.9%
2013	121,685	3279	970	372	1760	883	3985	6.0%	4102	7204	8.6%
2014	123,396	3279	993	448	2073	1006	4520	6.3%	4688	8202	9.3%
2015	125,023	3279	1009	509	2386	1141	5045	6.7%	5274	9178	10.0%
2016	126,811	3279	1033	572	2698	1288	5590	7.0%	5274[2]	9577	10.1%
2017	128,180	3279	1056	582	2748	1312	5698	7.0%	5274	9660	10.1%
2018	129,982	3279	1072	595	2807	1340	5813	7.0%	5274	9748	10.0%
2019	131,775	3279	1096	608	2871	1370	5945	7.0%	5274	9849	10.0%
2020	133,721	3279	1120	622	2937	1402	6080	7.0%	5457	10,136	10.0%
2021	135,456	3279	1143	635	2996	1430	6204	7.0%	5457	10,231	10.0%
2022	137,329	3279	1159	648	3059	1460	6326	7.0%	5641	10,507	10.0%
2023	139,226	3279	1183	662	3127	1493	6465	7.0%	5641	10,613	10.0%
2024	141,266	3279	1206	677	3197	1526	6607	7.0%	5825	10,905	10.0%
2025	143,094	3279	1222	691	3261	1556	6730	7.0%	5825	10,999	10.0%

Notes:

1. Landfill gas, anaerobic digestion and cellulosic biomass quantities are unchanged for the accelerated RPS.
2. Wind capacity remains the same some years after 2015 because biomass resource types were all projected to continue to increase from 2016 through 2025 at the same rate as forecast demand. In order to maintain the RPS as close as possible to a constant 10%, wind capacity growth was modeled at 75 MWe increments every few years.

Source: Reference 9.2-3

Table 9.2-4 Total Biomass Resources Available – State of Michigan

Biomass Resource	Resource Available (thousand tons/year)
Crop Residues	3586
Switchgrass on CRP Lands	1451
Forest Residues	1275
Methane from Landfills	446
Methane from Manure Management	30
Primary Mill Wood Waste	1314
Secondary Mill Wood Waste	86
Urban Wood Waste	1196
Methane from Domestic Wastewater	16
Total Biomass	9400

Source: Reference 9.2-8

Table 9.2-5 Estimated Coal-Fired Power Plant Emissions

Emitted Compound	Emission Factor (lb/MWh)[1]	Plant Thermal Rating (MWt)[2]	Capacity Factor (%)[3]	Total Annual Emissions (tons/year)
Particulate Matter (Filterable PM10)	0.0008	4500	90	48
NOx	0.022	4500	90	1,330
SO_2	0.037	4500	90	2,260
CO_2	293.3	4500	90	17,750,000
Mercury	1.60E-06	4500	90	0.1

Notes:.

1. Emissions Factors are developed from Reference 9.2-15 based on the following (Emission Factors include applicable control method):
   a. Boiler Type, PC, dry bottom, tangentially fired, sub-bituminous
   b. Power River Basin Sub-bituminous Coal
   c. Fuel heat value of 8200 Btu/lb
   d. Fuel Ash Content by Weight = 5.7%, average value from Reference 9.2-16
   e. Fuel Sulfur Content by Weight = 0.35%, average value from Reference 9.2-16
   f. Particulate Matter Control – Fabric Filter, 99.9% Reduction, Reference 9.2-15
   g. NOx Control –95% Reduction, Reference 9.2-15
   h. SOx Control – 95% Reduction, Reference 9.2-15
   i. CO_2 emissions are based on CO_2 default emission factor
   j. Mercury – Emission factor based on uncontrolled emission and a typical control efficiency of 90%.
2. Total Annual Emissions is determined based on a plant thermal rating of 4500 MWt (Section 3.2.1) and a capacity factor of 90% (based on performance of modern plants).

Table 9.2-6 Estimated Natural Gas-Fired Power Plant Emissions

	Emissions Rate (pounds per MMBtu)	Total Annual Emissions (tons)
NOx Emissions	0.092	1,860
SOx Emissions	0.001	20
PM	0.007	140
CO	0.04	800
CO_2	117	2,360,000

Total Emissions are determined based on the following:

Plant Capacity	1500 MWe
Conversion	3414 Btu/kw-hr
Capacity Factor	90%
Conversion	8760
Total (MMBtu/year)	40,373,960

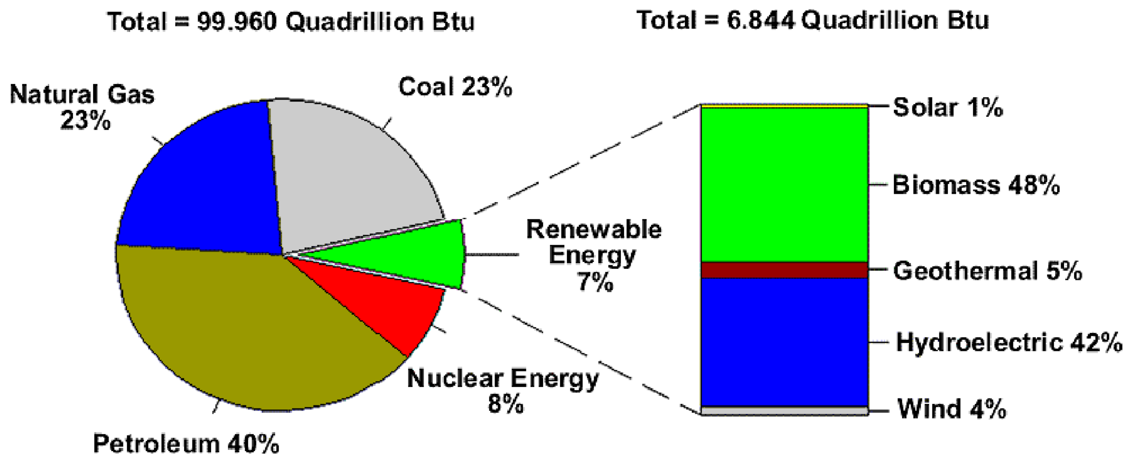
Source: Reference 9.2-19

Table 9.2-7 Impacts Comparison Summary

Impact Category	Proposed Action Fermi 3	Coal-Fired	Natural Gas-Fired
Siting	Fermi	Fermi or Alternate Site	Fermi or Alternate Site
Assumed Generating Capacity (MWe)	1600	1600	1600
Land Use – Plant Footprint	SMALL	MODERATE	SMALL
Land Use – Construction	SMALL	SMALL (expected, data not available)	SMALL (expected, data not available)
Land Use – Fuel Source	SMALL	MODERATE	MODERATE
Ecology	SMALL	SMALL to MODERATE	SMALL to MODERATE
Water Use and Quality	SMALL	SMALL	SMALL
Air Quality	SMALL	MODERATE	SMALL to MODERATE
Waste	SMALL	MODERATE	SMALL
Human Health	SMALL	SMALL	SMALL
Socioeconomic	MODERATE-Beneficial	MODERATE - Beneficial	SMALL to MODERATE - Beneficial
Historical and Archeological Resources	SMALL	SMALL	SMALL
Environmental Justice	SMALL	SMALL	SMALL

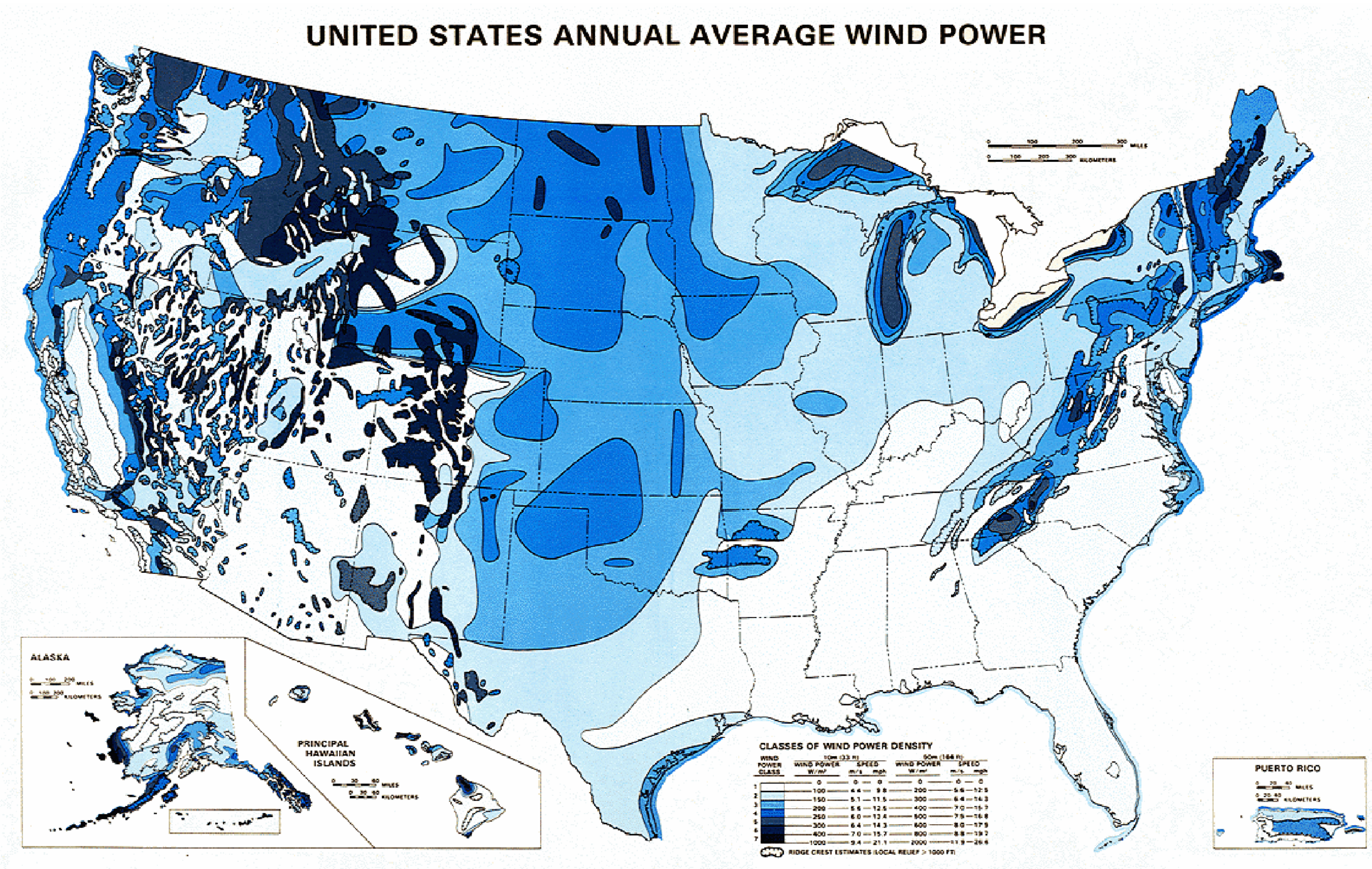
SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
MODERATE: Environmental effects are sufficient to alter noticeably, but not destabilize, any important attribute of the resource.
LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Figure 9.2-1 Role of Renewable Energy Consumption in U.S. Energy Supply, 2006



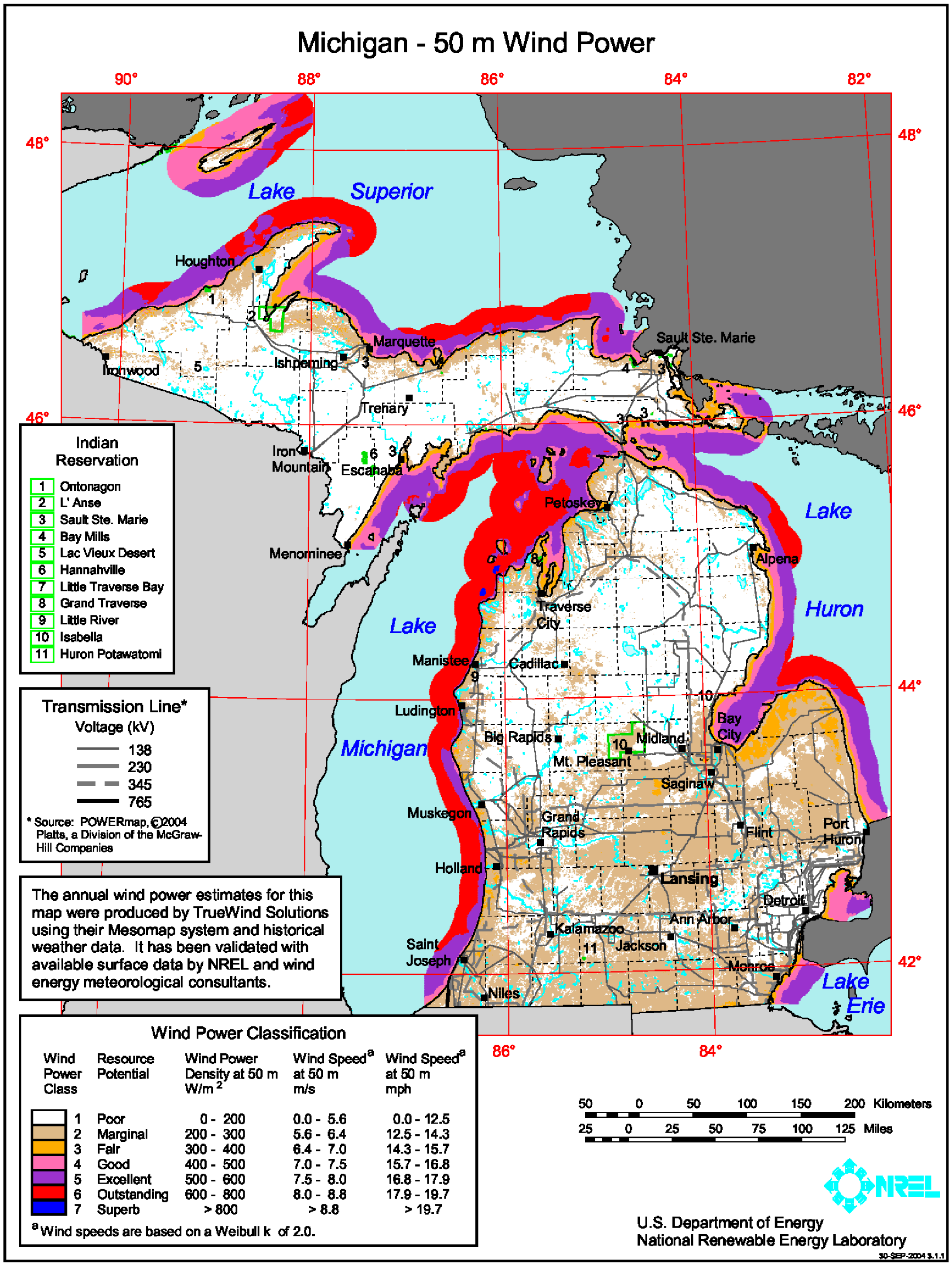
Source: Reference 9.2-23.

Figure 9.2-2 Annual Average Wind Power



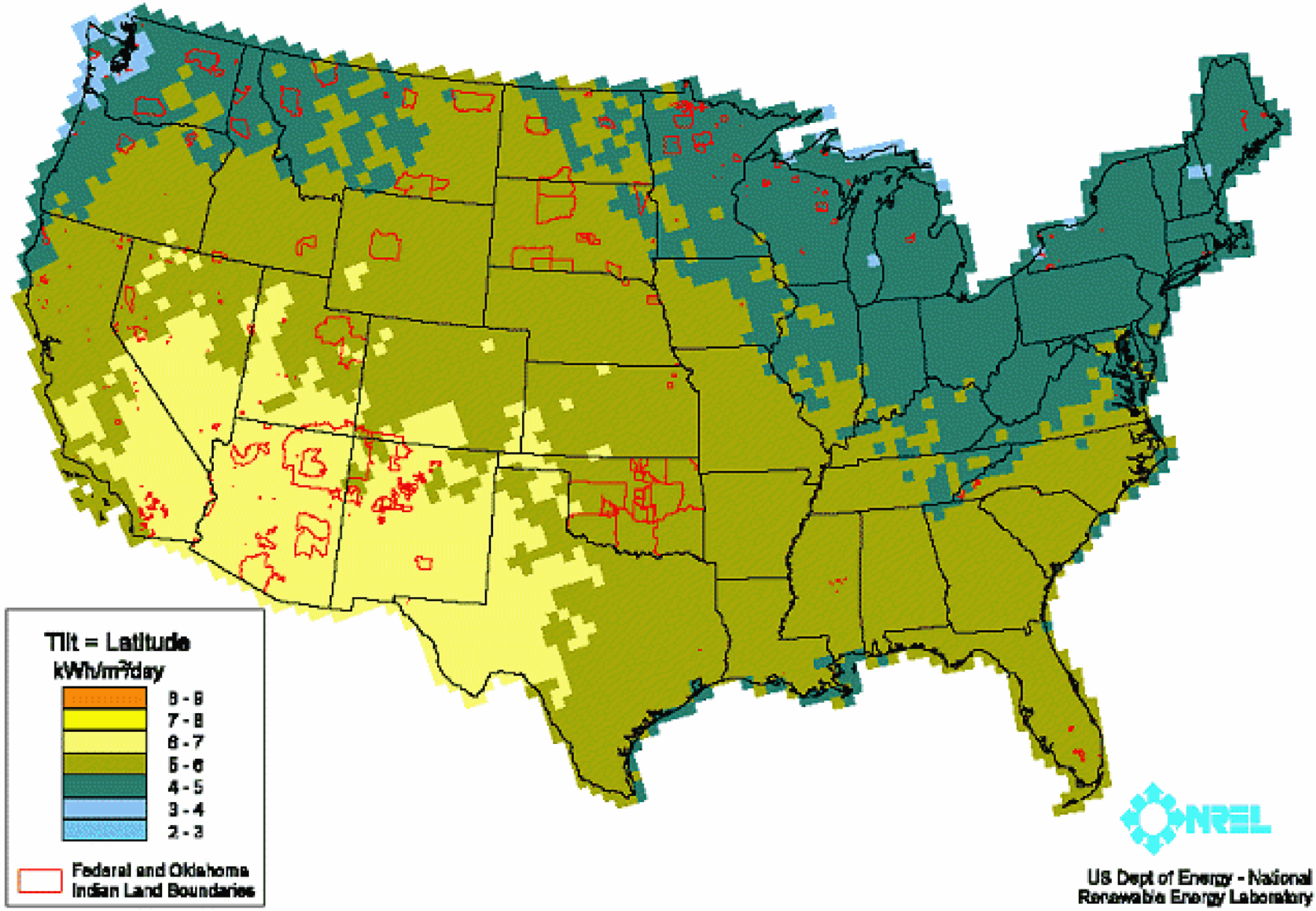
Source: Reference 9.2-24.

Figure 9.2-3 Michigan – 50-meter Wind Power Map



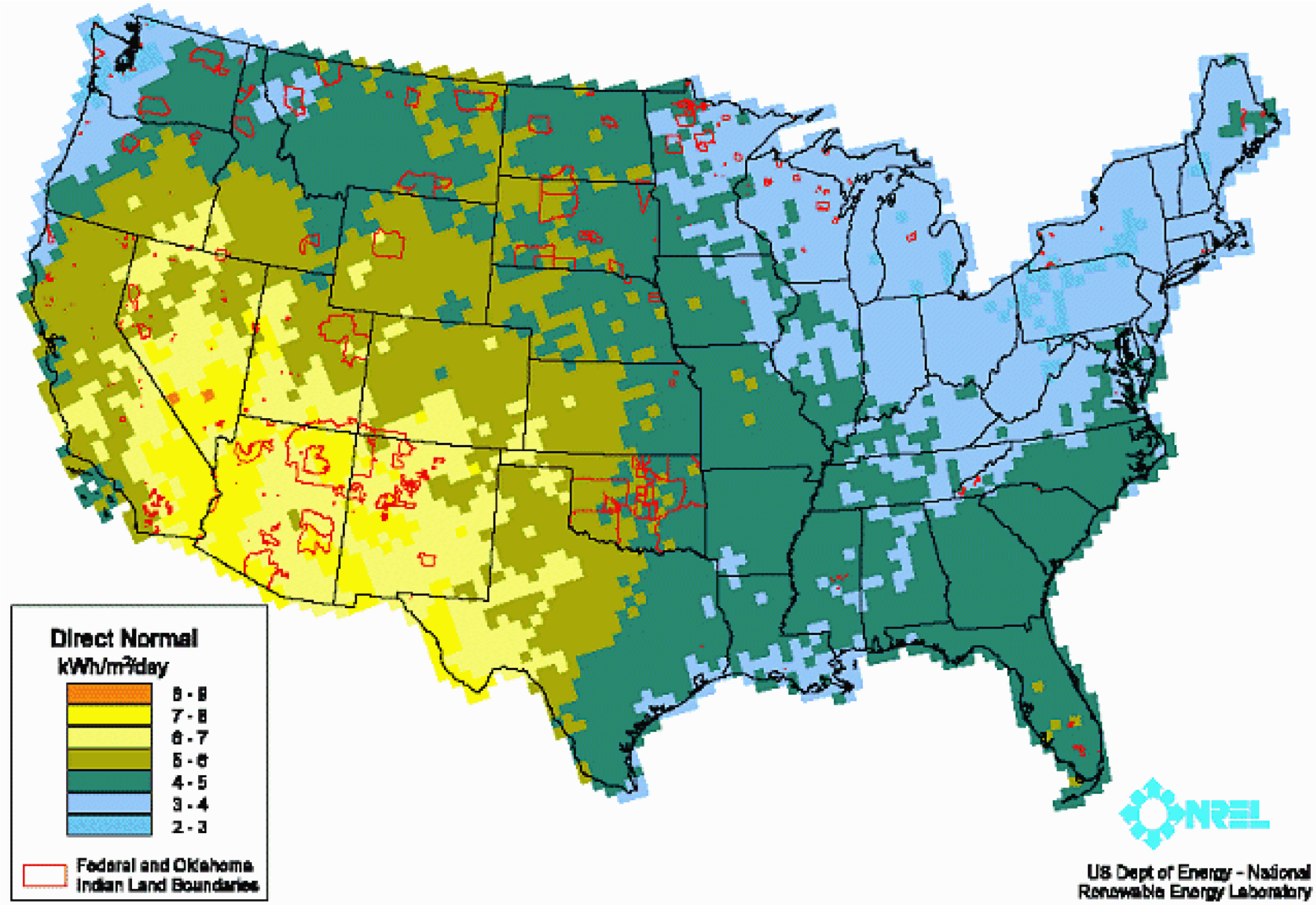
Source: Reference 9.2-25.

Figure 9.2-4 Solar Photovoltaic Resource Potential



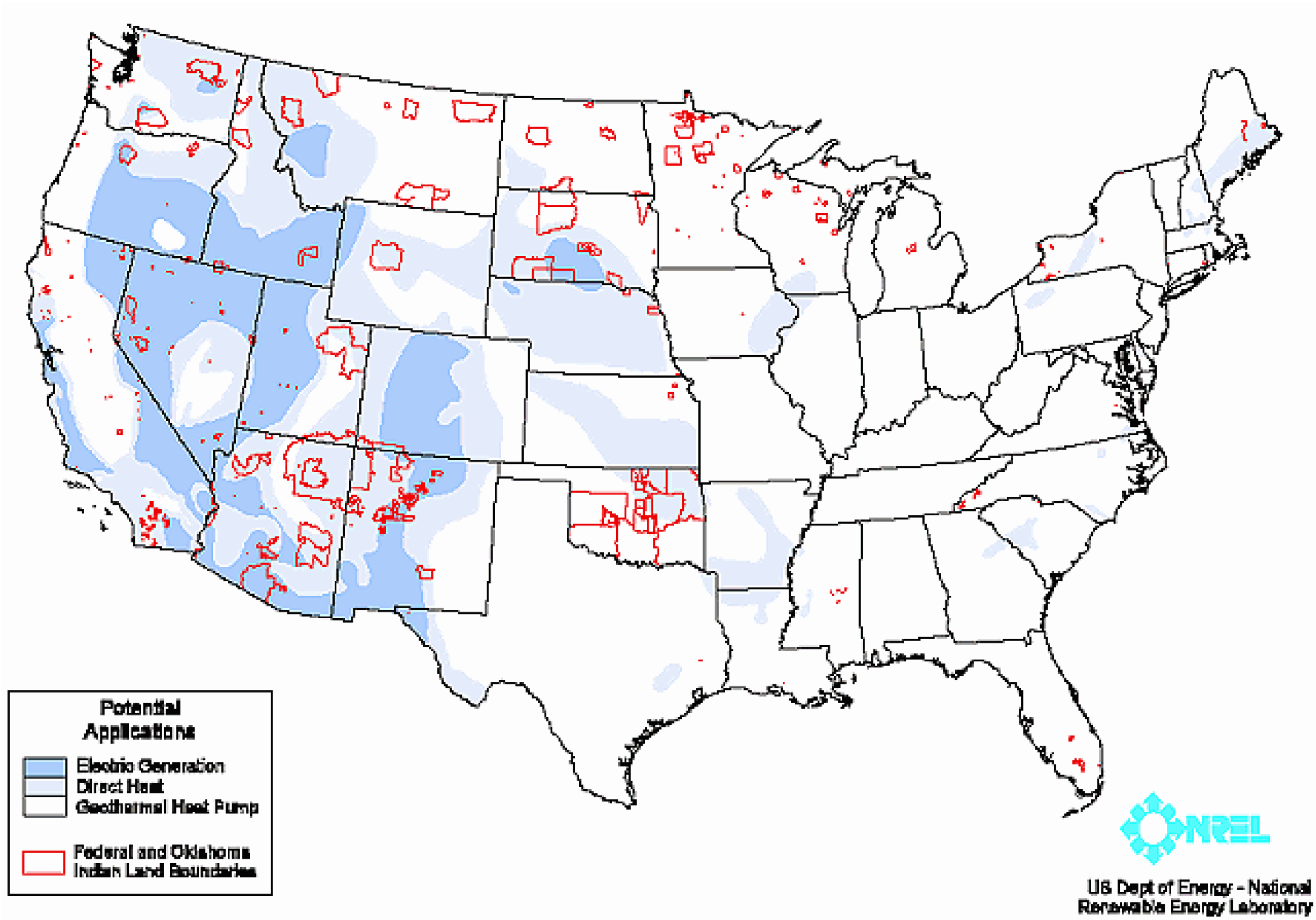
Source: Reference 9.2-26.

Figure 9.2-5 Concentrated Solar Power Resource Potential



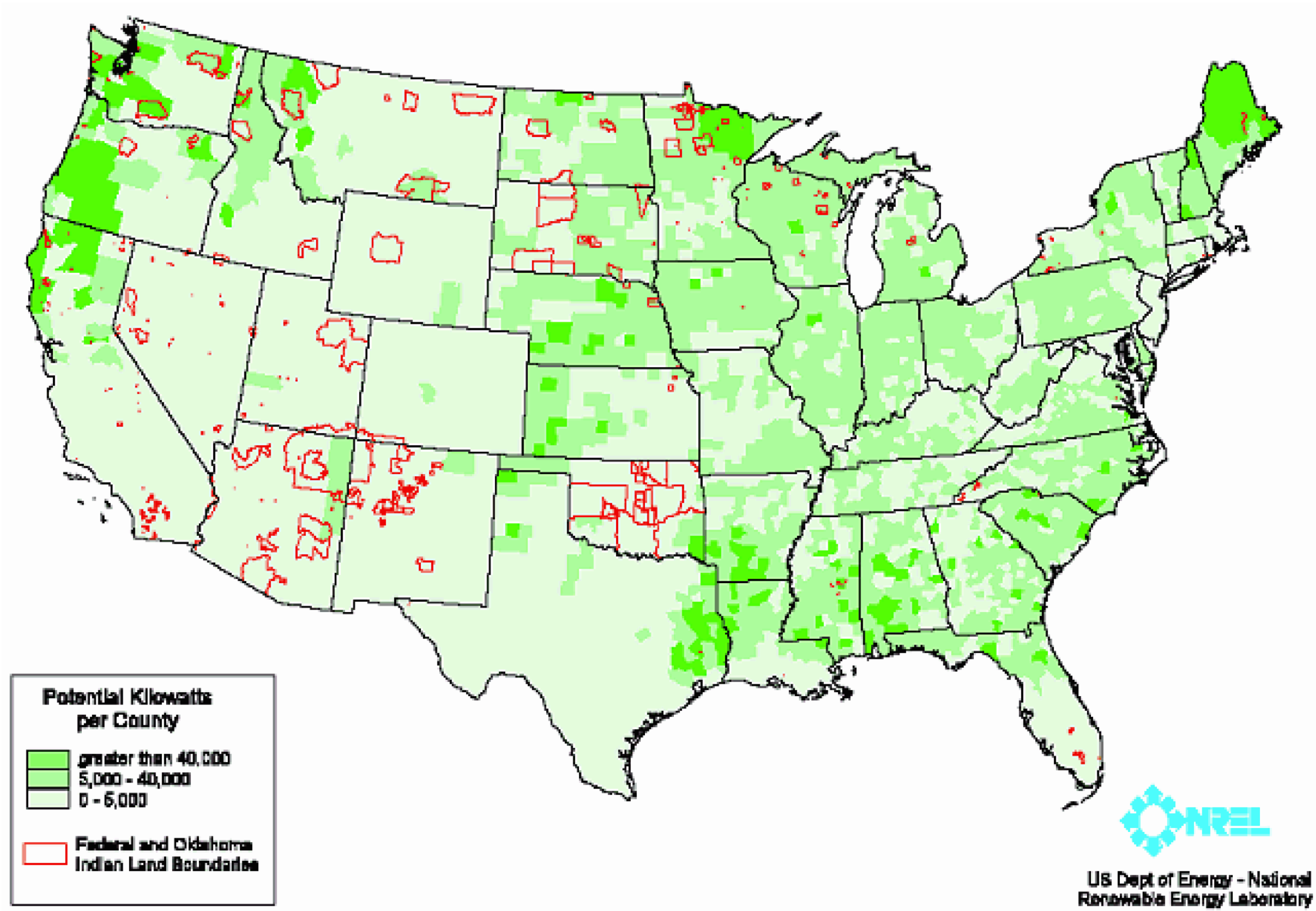
Source: Reference 9.2-26.

Figure 9.2-6 Geothermal Resource Potential



Source: Reference 9.2-26.

Figure 9.2-7 Biomass and Biofuels Resource Potential



Source: Reference 9.2-26.

9.3 Site Selection Process

This section presents the siting process completed by Detroit Edison to identify a site for the location of a new nuclear facility. It identifies and evaluates potential locations for a new facility. The sites evaluated within the analysis include greenfield sites, sites housing existing fossil fuel fired electric generating units, and sites previously licensed for the construction of nuclear facilities. The NRC previously found those sites licensed for construction of nuclear facilities as acceptable relative to other potential sites within the Region of Interest (ROI).

9.3.1 The Site Selection Process and Objectives

9.3.1.1 General Process and Objective Description

Detroit Edison commissioned a siting study that occurred between 2006 and 2008 in an effort to identify the preferred and alternative locations for new generating capacity. Additional information regarding this Plan is available in Chapter 8. This effort is collectively being referred to as "the Study."

The methodology employed by the Study is described below and illustrated in Figure 9.3-1. First, a Region of Interest (ROI)/Study Area was defined as the Detroit Edison service area. Second, Potential Sites within the ROI were identified through an evaluation of state maps, atlases, 1:250,000 scale USGS, the Michigan Department of Environmental Quality brownfield database, and Detroit Edison's sites utilized for power generation. This process resulted in the identification of 24 Potential Sites. Third, Candidate Sites were chosen from the Potential Sites. Further research of publicly available documents occurred to determine which sites were technically and environmentally suitable. Additionally, site reconnaissance visits were made to each of the Potential Sites to confirm the information gathered from desktop sources. Sites with unsuitable features were eliminated from consideration. This resulted in the selection of eight Candidate Sites which were then each scored and ranked using environmental and technical criteria. The scoring and ranking concluded that the Fermi site is the appropriate proposed site and identified the Belle River and Greenwood Energy Center sites as the first and second alternatives, respectively.

9.3.1.2 Siting Constraints and Limitations

The Study was constrained to information available via the Internet, in-house files, and other readily available sources. On-site visits were made by technical experts to the Potential Sites. Limited outside contacts were made so as to protect project confidentiality.

9.3.2 Selected Areas – Methodologies and Descriptions

9.3.2.1 Region of Interest (ROI)/Study Area

9.3.2.1.1 Site Selection Methodology for the ROI

The ROI for a proposed nuclear unit is defined as Detroit Edison's service area and is consistent with the major load centers supplied by the proposed plant. The service area is the geographical area initially considered in the site selection process. The size of the selected ROI is sufficient to provide environmental diversity.

9.3.2.1.2 ROI Description

Detroit Edison's service area consists of approximately 7600 square miles in 11 counties within southeastern Michigan, including the city of Detroit. There are presently major generation facilities through-out the service area. Figure 9.3-2 illustrates the electric utility services areas throughout Michigan. Figure 9.3-3 illustrates Detroit Edison's Service Area and the power generation facilities within that service area.

The ROI contains the major population center of the city of Detroit. Water bodies available for cooling include Lake Erie and Lake Huron. Major transportation routes through the ROI include Interstates 96, 275, 94, and 75.

9.3.2.2 Potential Sites

Potential Sites are those sites first identified from within the ROI/Study Area. The Potential Sites were identified and evaluated based on general siting criteria. A variety of greenfield, brownfield, and Detroit Edison's existing generation sites were considered as Potential Sites. Completion of the following methodology resulted in the identification of 24 Potential Sites.

9.3.2.2.1 Potential Site Selection Methodology

9.3.2.2.1.1 General Criteria for Identifying Potential Sites

The identification of Potential Sites required the establishment of siting criteria reflecting basic technical and environmental requirements. Except for the Detroit Edison sites, general criteria were used to identify Potential Sites, whereas more specific criteria were used to evaluate Candidate Sites.

The general criteria used to identify Potential Sites were basic and intuitive and applied on a broad scale. These general criteria were used to identify areas appearing to hold potential for supporting an electric generating facility. Conversely, areas failing to meet the general criteria were excluded from consideration. Potential Sites were then selected from among the potential areas. General criteria applied in the siting study included aspects such as:

- Proximity to transmission lines
- Proximity to rail
- Proximity to transportation corridors
- Proximity to water supply
- No obvious environmental concerns (e.g., no large expanses of wetlands, no nearby natural resource conservation areas, no complex terrain, and few residences/sensitive receptors etc.).

9.3.2.2.1.2 Identification and Evaluation of Potential Greenfield Sites

A greenfield site consists of land not previously developed or polluted (Reference 9.3-2). The EnergyVelocity database (Reference 9.3-4) was used to identify potential greenfield areas within the ROI exhibiting the identified general criteria indicating potential suitability for the construction and operation of a new electric generating unit. EnergyVelocity is a commercial database providing information on infrastructure, existing industrial facilities, certain environmental resources, and other information within a given locale. The EnergyVelocity database was configured to show those areas meeting the general criteria described above.

After areas exhibiting the general criteria were identified, they were reviewed in greater detail to confirm and supplement the EnergyVelocity query results. These areas were also reviewed to identify specific parcels (i.e. potential sites) within the areas suitable for the construction of a electric generating facility from a technical and environmental perspective. The more detailed review of these areas consisted of an examination of the corresponding 7.5 minute USGS quadrangles, aerial photographs, atlases, road maps, and Internet searches. Sites that met the general criteria after completing the more detailed review were retained as Potential Sites. Areas deemed unsuitable for technical and/or environmental reasons were eliminated from further consideration.

9.3.2.2.1.3 **Identification and Evaluation of Potential Brownfield Sites**

Potential brownfield sites were identified through review of the Michigan Department of Environmental Quality (MDEQ) database. As defined by the MDEQ, a brownfield site is an abandoned, idle, or under used industrial and commercial property, often in urban areas, where expansion or redevelopment is hindered or complicated by real or perceived environmental conditions. (Reference 9.3-3).

Brownfield sites that were located within the ROI/Study Area were evaluated using the general technical and environmental criteria. Sites meeting the general criteria were retained as Potential Sites.

9.3.2.2.1.4 **Identification and Evaluation of Potential Sites with Existing Generation**

Detroit Edison’s existing sites were retained as Potential Sites, including:

- Belle River/St. Clair
- River Rouge
- Trenton Channel
- Fermi
- Greenwood
- Monroe
- Harbor Beach
- Conners Creek
- Marysville

9.3.2.2.2 Identified Potential Sites

Completion of the above activities resulted in the identification of 24 Potential Sites. Table 9.3-1 lists the identified Potential Sites. Figure 9.3-4 illustrates the locations of these Potential Sites.

9.3.2.3 Candidate Sites

Candidate Sites are those sites selected after screening the 24 identified Potential Sites through additional research and site reconnaissance. The following discussion provides the methodology utilized to select Candidate Sites, identifies the location of the Candidate Sites, and presents the method used to evaluate the Candidate Sites to arrive at the proposed and alternative sites.

9.3.2.3.1 Candidate Sites Selection Methodology

Candidate Sites were selected through the use of site reconnaissance visits (i.e., “windshield surveys”) and a technology specific screening for each of the Potential Sites. These on-site inspections occurred to verify and supplement the information obtained during the initial screening. The technology specific screening reviewed each site for its ability to house nuclear technology. The site reconnaissance visits and technology screening resulted in the elimination of 16 Potential Sites for technical or environmental reasons. These reasons included, but were not limited to, space limitations, proximity to resort area, inadequate water quantity or quality. Table 9.3-2 provides information documenting the Potential Site screening and elimination process used to identify the Candidate Sites.

9.3.2.3.2 Candidate Sites Evaluation Methodology

9.3.2.3.2.1 Candidate Site Scoring Methodology

The remaining eight sites were considered Candidate Sites and were carried forward into the next stage of analysis. Candidate Sites were evaluated using a technology-specific, criteria based scoring system. The criteria used in evaluating Candidate Sites were more detailed and technology-specific than those used in identifying the Potential Sites.

As indicated above, evaluation of the Candidate Sites utilized a criteria-based scoring system. The scoring system included the following steps:

1. Two categories of criteria were established: environmental and technical.
2. Each of the categories of criteria was assigned a weight (percent format) based on a judgment of its relative importance in determining the suitability of a site for nuclear power generation. For the purposes of the siting study, the following environmental and technical weights were assigned as the base case:

	Environmental (percent)	Technical (percent)
Nuclear	41	59

3. Within each category, each criterion was assigned a weight, again based on a judgment of its relative importance to other criteria within the same category. The sum of the weights for the environmental criteria equaled the total environmental weight, while the sum of the weights for the technical criteria equaled the total technical weight.
4. Each criterion was further broken down into subcriteria, each of which was assigned a judgment-based weight. The sum of the weights of the subcriteria equaled the weight of the associated criterion.
5. Each site was evaluated for each siting subcriterion by assigning a score (1, 3, or 5, except for transmission stability) for that subcriterion. A score of 5 was most favorable, 3 was moderately favorable, and 1 was least favorable. Each score was then multiplied by the subcriterion's percentage weight and summed to determine a total score.
6. The sites were then ranked based on the numerical scores. The highest scoring site was designated as the preferred site, the second highest scoring site was designated as an alternate site, and so forth.

9.3.2.3.2.2 **Candidate Site Scoring Criteria**

The following defines the environmental and technical evaluation criteria assigned. Professional judgment was used to select the relative desirability of the criteria. Methodologies used in the Candidate Site evaluation process included factors such as: (1) importance factors, (2) preference functions, (3) utility functions, (4) weighting factors, (5) ranking scales, (6) scoring schemes, (7) rating systems, and (8) sensitivity analyses.

9.3.2.3.2.2.1 **Environmental**

Ecology/Natural Resources

<u>Documented Threatened and Endangered Species</u>

Definition: Species (or habitats) that are state or federally listed as endangered or threatened. Sites will be scored using criteria such as the diversity and quality of wildlife cover types in the site vicinity and the potential number of listed species for the vicinity, as available on the Internet. The site vicinity includes the site and the area surrounding the site.

Data Source: Agency websites and in-house files.

Score	Criteria
5	Low potential for protected species to occur in the vicinity.
3	Moderate potential for protected species to occur in the vicinity.
1	High potential for protected species to occur in the vicinity.

<u>Wetlands/Waters of the US</u>

Definition: Wetlands are defined as areas that are periodically or permanently inundated or saturated by surface or groundwater and support vegetation adapted for life in saturated soil conditions. Agency regulated wetlands and waters typically include navigable waters, lakes, rivers, perennial streams, and impoundments.

Data Source: NWIS maps, agency websites, and in-house files, as available.

Score	Criteria
5	No regulated wetlands/waters within 1 mile of site.
3	No regulated wetlands/waters on-site, but adjacent to site.
1	Regulated wetlands/waters on-site.

Impact on Designated Scenic, Natural, Recreational, or Wildlife Areas

Definition: These areas include parks, state or federal forests, monuments, recreational areas, wildlife areas, wilderness/wilderness study areas, wild and scenic rivers, and scenic transportation routes. Sites will be scored by assessing their proximity to such areas.

Data Source: State and federal natural resource agency websites, atlases, road maps.

Score	Criteria
5	No designated areas within 5 miles of site.
3	No designated areas within 1 mile of site.
1	Designated areas within 1 mile of site.

Disruption of Natural Habitat

Definition: Frequency/degree of disruption of local wildlife habitat.

Data Source: State and federal natural resource agency websites and in-house files.

Score	Criteria
5	Regularly disturbed area (agricultural, commercial/industrial use).
3	Occasionally disturbed area.
1	Undisturbed area.

Impacts on Water Quality

Definition: Location of site in relation to water bodies.

Data Source: Online sources, maps, and in-house files.

Score	Criteria
5	No waters within 1 mile of site.
3	No waters within 0.5 mile of site.
1	Waters within 0.5 mile of site.

Land Use

Existing Land Ownership

Definition: Private or public property.

Data Source: Online agency sources and atlases.

Score	Criteria
5	Detroit Edison ownership.
3	Private ownership.
1	Government ownership.

Existing Land Use (Within 1 Mile)

Definition: Type of land use within 1 mile of the proposed plant.

Data Source: Online agency sources and atlases.

Score	Criteria
5	Industrial or multiple use.
3	Large acreage residential, agricultural.
1	Green space, open space, park, developing residential.

Nearby Airports

Definition: Private, public, or military airports near site.

Data Source: Online agency sources and atlases.

Score	Criteria
5	No airport facilities present within 10 miles of site.
1	Site within 10 miles of nearest airport.

Buffer between Facility and Receptors

Definition: The distance between and type of buffer between the proposed plant and nearby residences, facilities (including buildings), and population centers.

Data Source: Online maps and hard copy maps.

Score	Criteria
5	Wide buffer area that will greatly diminish noticeable effects of plant on surrounding area.
3	Moderate buffer area that will lessen effects, with some effects noticeable at nearby receptors.
1	No buffer or minimal buffer area.

Socioeconomics

Socioeconomic Resources

Definition: Impacts on traffic, demographics, employment, and housing are subjectively considered.

Data Source: Online sources and in-house files and highway maps.

Score	Criteria
1 to 5	Sites will be scored using information about the site and nearby areas. Sites with the most positive impact on socioeconomic resources will be assigned the score of 5, with the other sites scored as moderate (3) or low positive (or high negative) impact (1).

Noise Impacts

Definition: The impacts of increased noise levels resulting from the operation of the proposed plant on nearby residences, facilities (including buildings), and population centers.

Data Source: Online sources, maps, and in-house files.

Score	Criteria
5	No residences or facilities within 2 miles of the site.
3	One to five residences or facilities within 2 miles of the site.
1	More than five residences or facilities within 1 mile of the site.

Cultural Resources

Definition: Historic sites listed in the National or State Register of Historic Places as well as resources that are eligible for listing. Sites will be scored according to the proximity to known archaeologically significant areas or historic sites.

Data Source: Online sources (SHPO and NPS websites) and in-house files.

Score	Criteria
5	No listed resources within 1 mile of site.
3	No listed resources within 0.5 mile of site.
1	Listed resources within 0.5 mile of site.

Visual Impact

Definition: Visual effect of site development on the surrounding area.

Scoring: Sites will be scored according to the potential visual impact of site development on receptors in the vicinity. Sites with minimum impact will be assigned the score of 5, with the other sites given relative scores.

Potential for Hazardous Material Contamination

Definition: Potential for onsite contamination.

Data Source: Agency websites.

Score	Criteria
5	Records available. No significant contamination expected.
3	Minor contamination may be in the area.
1	Significant contamination may be in the area.

Associated Linear Facilities

Definition: The environmental features of transmission line and water line routes.

Score: Each site will be evaluated and scored on the environmental sensitivity of the route landscape between the site and the nearest interconnection location or source. The site with the least sensitive route environments will be assigned a score of 5. The remaining sites' scores will be assigned relative to the highest scoring site.

Community Perception/Receptivity to New Facilities

Definition: Local attitudes and perceptions about new nuclear facilities and presence of nuclear materials on-site.

Scoring: Sites are ranked according to probable resistance to new nuclear facilities by residents of the site area. The site with the least probable resistance will be assigned the score of 5, with relative scores given to other sites. Environmental justice will be considered.

9.3.2.3.2.2.2 **Technical**

Site Development

Site Topography

Definition: Terrain and elevation range on and near the site.

Data Source: Maps, agency websites, and in-house files.

Score	Criteria
5	Site relatively flat.
3	Site has moderate variations in topography.
1	Major topographic features on-site.

Foundation, Earthwork, and Pipe Installation Conditions

Definition: Degree that conditions on-site could accommodate construction and installation work.

Score	Criteria
5	Conditions favorable to foundation, earthwork, and pipe installation.
3	Moderate challenges for foundation, earthwork, and pipe installation.
1	Site poses significant challenges to foundation, earthwork, and pipe installation work.

Groundwater Construction Impacts

Definition: Degree that site construction could affect groundwater.

Score	Criteria
5	Groundwater deeper than 12 feet below site surface.
3	Groundwater 6 to 12 feet below site surface.

1	Groundwater closer than 6 feet to site surface.

Flood Potential

Definition: Potential for floods on-site.

Data Sources: Agency websites, maps, and in-house files.

Score	Criteria
5	Site is outside floodplain at high elevation in reference to nearest surface-water.
3	Site is outside floodplain at moderate elevation in reference to nearest surface-water.
1	Site is at or below elevation of nearest surface-water or is in floodplain.

Geological/Seismic Activity

Definition: Known or recorded seismic activity in the vicinity.

Data Source: Agency websites, in-house files, and maps.

Score	Criteria
5	Minor recorded seismic activity in the vicinity.
3	Moderate seismicity recorded in the vicinity.
1	Site vicinity has been affected by significant seismic activity.

Utility Displacement/Replacement

Definition: Possibility that existing utilities would need relocation or replacement to accommodate site development.

Data Source: In-house files and maps.

Score	Criteria
5	No existing utilities would be displaced and/or need replacement.
3	Some replacement and/or displacement would be required.
1	Significant disruption of utilities would be required.

Cogeneration Potential

Definition: Cogeneration is the simultaneous production of heat and power in a single thermodynamic process.

Scoring: Sites will be scored according to the potential for cogeneration in the professional judgment of the siting specialist. Sites with maximum potential will be assigned the score of 5, with the other sites given relative scores.

Transmission System - Development

Distance from Transmission

Definition: This will be based on estimated length of new transmission lines from the generation site to the nearest substation.

Scoring: Sites are ranked according to estimated length of new transmission. The highest ranked sites (least length) will be assigned the score of 5, with relative scores given to other sites.

Transmission System Reliability/Capacity

Definition: This will be based on estimated reliability and capacity of transmission infrastructure and facilities in the site area.

Scoring: Sites are ranked according to estimated existing capacity to handle increased electric transmission loads. The highest ranked sites (most reliable and highest capacity) will be assigned the score of 5, with relative scores given to other sites. Sites with inadequate reliability or capacity, or where system stability issues exist that cannot be remedied without significant system upgrades, will be eliminated as candidate sites.

Transportation - Development

Highway Transportation

Definition: Proximity of site to nearest highway of sufficient capacity for use by construction vehicles and equipment.

Score	Criteria
5	Suitable highway within 5 miles.
3	Suitable highway within 10 miles.
1	Suitable highway 20 or more miles away.

Road Displacement/Replacement

Definition: Possibility that existing roads would need relocation or replacement to accommodate site development traffic.

Score	Criteria
5	No existing roads would be displaced and/or need replacement.
3	Some replacement and/or displacement of roads would be required.
1	Significant disruption of area roads would be required.

Water Resources – Development

Adequacy of Water Source for Baseload Plant

Definition: Ability of primary water source to meet needs of baseload plant.

Score	Criteria
5	Primary source meets or exceeds baseload plant needs.
3	Primary source meets some, but not all baseload plant needs.
1	Primary source has insufficient water to meet baseload plant needs.

Distance to Adequate Source of Water

Definition: Site location regarding proximity to primary water source.

Score	Criteria
5	Source either on-site, adjacent, or within 5 miles of site.
3	Source more than 5 miles from site.
1	Air-cooled condensers required.

Static Head

Definition: Static head is the pressure exerted by a pool of liquid. Because of the weight of the liquid, the pressure is greater at the bottom of the pool than at the top, which affects pump capacity needs.

Scoring: Sites are ranked according to estimated static head that would need to be overcome by pumps for site construction work. The highest ranked site (least static head) will be assigned the score of 5, with relative scores given to other sites.

Makeup Water Quality

Definition: Makeup water quality affects the life of various plant components (higher quality water means less maintenance).

Scoring: Sites are ranked according to estimated makeup water quality available at the site. The site with the highest water quality will be assigned the score of 5, with relative scores given to other sites.

Groundwater Quality

Definition: Groundwater quality can affect the life of various plant pumps and components (higher quality water means less maintenance).

Scoring: Sites are ranked according to estimated groundwater quality available at the site. The site with the highest water quality will be assigned the score of 5, with relative scores given to other sites.

Feasibility of Well Field

Definition: Potential for development of an on-site well field.

Score	Criteria
5	Well field is feasible.
3	Well field development may be severely limited.

1 Well field not feasible.

Security Considerations

Definition: Prevention of potential risk from surrounding area to power plant activities during construction.

Scoring: Sites are ranked according to potential for maintaining security of construction. The site estimated to be able to maintain the greatest security during construction will be assigned the score of 5, with relative scores given to other sites.

Economics of Areas and Criteria Evaluated

Development Costs

Some of the principal site comparisons during the site selection process are on the basis of estimated costs, such as capital costs to prepare the site (cut/fill) and install facilities, transmission facilities, and fuel supply infrastructure. The method used to score each cost-based comparison will be to assign the point value of 5 to the lowest costs, the value of 1 to the highest cost site, and award intermediate scores on the basis of site costs.

Project costs can be separated into two categories: the power block capital costs and site development costs. The total power block capital costs will be assumed to be the same at each appropriate candidate site. However, each site has specific characteristics that can influence the total site development costs for the proposed power generation facilities at that particular site location. These factors, which will be evaluated on the basis of differentials in cost, include water supply pipelines, linear facilities, transmission lines, costs for plant cooling system, and delivered fuel costs. Indicative unit costs (e.g., dollars per mile) will be used for evaluations of development cost differentials.

Waste Disposal - Development

Dry Spent Fuel Storage Capacity

Definition: This will be based on estimated capacity of dry spent fuel storage on-site or in the site area.

Scoring: The highest ranked site (most capacity) will be assigned the score of 5, with relative scores given to other sites.

9.3.2.3.2.3 **Candidate Site Development Cost Estimates**

Site development costs were not specifically generated for each site. However, it was assumed that a “non-nuclear site,” one that did not have existing nuclear developments, would have significantly higher development costs than a site with existing nuclear units. Consequently, a “non-nuclear” site would be allocated a less favorable cost development score.

9.3.2.3.2.4 **Candidate Site Sensitivity Analysis**

Sensitivity analyses were performed to determine the effects of differently weighted environmental and technical factors on site rankings. These analyses identified the highest ranking sites over a range of various weightings. The base site evaluation was based on the percent allocation described above. Other weighting options between the technical and environmental factors are possible. Therefore, the sensitivity of the site rankings to the following weighting schemes was assessed:

	Environmental Factors Weighting (percent)	Technical Factors Weighting (percent)
Technical Empasis	30	70
Environmental Emphasis	70	30

It was not considered practical to explore the effect of varying the weightings assigned to each individual siting factor because of the virtually infinite number of possible combinations. Therefore, only the weighting options identified above were evaluated.

9.3.2.3.2.5 **Candidate Sites Evaluation Summary**

As indicated in Subsection 9.3.2.3.1, following the site reconnaissance and the collection and review of available site-specific information, potential sites were eliminated due to either environmental or technical reasons. The sites retained for further evaluation were deemed to be the Candidate Sites. Figure 9.3-5 illustrates the location of each of the Candidate Sites. Figure 9.3-6 through Figure 9.3-19 illustrate the land use and utility infrastructure within the immediate vicinity of each Candidate Site, except for Site M (Fermi). Further, site profiles containing environmental descriptions of the Candidate Sites are contained in Appendix 9A. Table 9.3-3 documents the evaluation scores of the Candidate Sites. Table 9.3-4 provides the final ranking of the Candidate Sites.

9.3.3 **Conclusion**

The environmental and technical evaluation of the eight Candidate Sites concluded that the Fermi site is preferable when both environmental and technical scores are taken into consideration (base case and average scores), and therefore should be the proposed site. The proposed site is the site for which Detroit Edison now seeks a COL to construct and operate a new nuclear facility. The Belle River site and the Greenwood Energy Center (GEC) site were identified as the first and second alternatives, respectively.

9.3.4 **References**

9.3-1 Michigan Public Service Commission, “Electric Utility Service Areas,” April 2002, http://www.cis.state.mi.us/mpsc/electric/map.htm, accessed 20 March 2008.

9.3-2 Merriam-Webster’s OnLine Dictionary, “Greenfield,” http://www.merriam-webster.com/dictionary/greenfield, accessed 17 July 2008.

9.3-3 Michigan Department of Environmental Quality, Land Redevelopment, “Brownfield Basics,” http://www.michigan.gov/deq/0,1607,7-135-3311_4110_23243---,00.html, accessed 17 July 2008.

9.3-4 Ventyx, “Velocity Suite Online” Subscription Service, https://velocitysuite.globalenergy.com/Citrix/MetaFrame/auth/login.aspx.

Table 9.3-1 Listing of Potential Sites

Site	County	Area of New Site (Acres)	Notes[1]
A	Monroe	1901	Greenfield
B	Lenawee	1407	Greenfield
C	Lenawee	1139	Greenfield
D	Lenawee	1072	Greenfield
E	Huron	1430	Greenfield
F	St. Clair	1280	Greenwood
G	St. Clair	320	Greenfield
H	Washtenaw	903	Greenfield
I	Tuscola	2139	Greenfield
J	Wayne	163	Brownfield
K	St. Clair	249	Greenfield
L	Wayne	383	Brownfield
M	Monroe	1260	Fermi
N	St. Clair	2086	Belle River/St. Clair
O	Huron	46	Harbor Beach
P	Wayne	106	River Rouge
Q	Wayne	115	Trenton Channel
R	St. Clair	27	Marysville
S	Wayne	69	Conners Creek
T	Monroe	930	Monroe
W1	Huron	3625	
W2	Huron	4851	
W3	Huron	3436	
W4	Huron	3066	

Notes: 1.Acreages shown in parentheses reflect the total site acreage for each existing site.

Table 9.3-2 Potential Site Evaluation Summary Table (Sheet 1 of 3)

Site	County	Total Area of Site (Acres)	Notes
A (Petersburg)	Monroe	1901	Acceptable
B (North Britton)	Lenawee	1407	Eliminated 30 to 40 residences onsite (too many) Proximity to similar Site C, more residences than Site C Insufficient rail line Long distance to some utilities Greenfield site Inadequate water supply at the site location Private land (disadvantage - not DTE owned)
C (South Britton)	Lenawee	1139	Acceptable
D (Blissfield)	Lenawee	1072	Eliminated Just outside service area 1.5 miles from Blissfield (close proximity) Greenfield site Inadequate water supply at the site location Private land (disadvantage - not DTE owned)
E (Pigeon)	Huron	1430	Eliminated In resort-type area, close to lake shore Greenfield site Affects visual characteristics of area Private land(disadvantage - not DTE owned)
F (Greenwood)	St. Clair	1280	Acceptable
G (Memphis North)	St. Clair	320	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a)
H (Dexter)	Washtenaw	903	Eliminated Many residences, possibly historic Mature forests Fairly close to state recreation sites Changes visual character of the area Greenfield site Private land(disadvantage - not DTE owned)

Table 9.3-2 Potential Site Evaluation Summary Table (Sheet 2 of 3)

Site	County	Total Area of Site (Acres)	Notes
I (Tuscola)	Tuscola	2139	Eliminated Both historical (older farmsteads) and environmental (mature woodlands, resort areas nearby) concerns Changes visual character of area Number of residences too high and of potentially historic type Requires rail upgrade Greenfield site Private land (disadvantage - not DTE owned) Inadequate water supply at the site location
J (Willow/South Huron)	Wayne	163	Eliminated Brownfield site Site too small for minimum nuclear size threshold of 500 acres(a) Close to Detroit Wayne County Metropolitan Airport Potential for significant wetland impact
K (Memphis South)	St. Clair	249	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a) Number of onsite residences too high, surrounded by residences and more possibly developing Private land (disadvantage - not DTE owned) Greenfield site Inadequate water supply at the site location
L (Livonia)	Wayne	383	Eliminated Brownfield with potential contamination Site too small for minimum nuclear size threshold of 500 acres(a)
M (Fermi)	Monroe	1260	Acceptable
N (Belle River)	St. Clair	2086	Acceptable
O (Harbor Beach)	Huron	46	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a) Transmission line upgrade required
P (River Rouge)	Wayne	106	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a)

Table 9.3-2 Potential Site Evaluation Summary Table (Sheet 3 of 3)

Site	County	Total Area of Site (Acres)	Notes
Q (Trenton Channel)	Wayne	115	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a)
R (Marysville)	St. Clair	27	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a)
S (Conners Creek)	Wayne	69	Eliminated Site too small for minimum nuclear size threshold of 500 acres(a)
T (Monroe)	Monroe	930	Eliminated Site too small and congested for minimum nuclear size threshold of 500 acres(a) Inadequate water supply at the site location
W1 (Port Austin)	Huron	6557	Acceptable
W2 (Caseville)	Huron	5757	Acceptable
W3 (Bay Port)	Huron	5743	Acceptable
W4 (Harbor Beach)	Huron	3066	Eliminated Forested wetlands and residences on the site Greenfield site

(a) Criteria evaluating a Potential Site included a minimum nuclear size threshold of 500 acres. The 500 acre minimum size criterion was developed using typical existing nuclear plant acreages listed in NUREG-1437, Volume I, Section 2.2.1.

Table 9.3-3 Evaluation Scores of Candidate Sites (Sheet 1 of 5)

Evaluation Criteria	Weighting Factor, %	Site A (Petersburg)	Site C (South Britton)	Site F (Greenwood)	Site M (Fermi)	Site N (Belle River)	Site W1 (Port Austin)	Site W2 (Caseville)	Site W3 (Bay Port)
Environmental Criteria (Total weight = 41%)									
1.0 Ecology/Natural Resources									
1.1 T&E Species	2	5	5	3	3	5	3	3	3
1.2 Wetlands/Waters of the US	2	1	1	1	3	3	3	3	3
1.3 Impacts on Designated Areas	1	3	5	3	1	5	1	3	3
1.4 Disruption of Natural Habitat	1	5	5	5	5	5	5	5	5
1.5 Impacts on Water Quality	1	1	1	1	1	1	1	1	1
Weighted Group Total		0.21	0.23	0.17	0.19	0.27	0.19	0.21	0.21
2.0 Land Use									
2.1 Existing Land Ownership	3	3	3	5	5	5	3	3	3
2.2 Existing Land Use	2	3	3	5	5	5	3	3	3
2.3 Nearby Airports	2	1	1	1	1	1	1	1	1
2.4 Buffer Between Facility and Receptors	4	3	3	5	5	5	3	3	3
Weighted Group Total		0.29	0.29	0.47	0.47	0.47	0.29	0.29	0.29
3.0 Socioeconomics									
3.1 Demographics/Employment/Housing	1	5	5	5	3	3	1	1	1
3.2 Noise Impacts	2	1	1	5	3	3	1	5	5
3.3 Cultural Resources	1	5	5	5	5	5	1	5	5
3.4 Visual Impact	3	1	1	5	5	5	1	1	1
Weighted Group Total		0.15	0.15	0.35	0.29	0.29	0.07	0.27	0.27

Table 9.3-3 Evaluation Scores of Candidate Sites (Sheet 2 of 5)

Evaluation Criteria	Weighting Factor, %	Site A (Petersburg)	Site C (South Britton)	Site F (Greenwood)	Site M (Fermi)	Site N (Belle River)	Site W1 (Port Austin)	Site W2 (Caseville)	Site W3 (Bay Port)
4.0 Potential for Hazardous Material Contamination									
4.1 Potential for Onsite Contamination	4	3	3	5	5	5	3	3	3
Weighted Group Total		0.12	0.12	0.20	0.20	0.20	0.12	0.12	0.12
5.0 Associated Linear Facilities									
5.1 Route Environment	2	3	3	5	5	5	5	5	5
Weighted Group Total		0.06	0.06	0.10	0.10	0.10	0.10	0.10	0.10
6.0 Public Receptivity									
6.1 Public Receptivity	10	3	3	1	5	3	1	1	1
Weighted Group Total		0.30	0.30	0.10	0.50	0.30	0.10	0.10	0.10
Weighted Environmental Total	41	1.13	1.15	1.39	1.75	1.63	0.87	1.09	1.09
Technical Criteria (Total weight = 59%)									
7.0 Site Development									
7.1 Site Topography	3	5	5	5	5	5	5	5	5
7.2 Foundation, Earthwork, Pipe Installation Conditions	3	5	5	5	3	3	5	5	5
7.3 Groundwater Construction Impacts	3	5	3	3	3	3	1	3	5
7.4 Flood Potential	3	3	3	3	1	1	1	1	3
7.5 Geologic/Seismic Activity	6	5	5	5	5	5	5	5	5

Table 9.3-3 Evaluation Scores of Candidate Sites (Sheet 3 of 5)

Evaluation Criteria	Weighting Factor, %	Site A (Petersburg)	Site C (South Britton)	Site F (Greenwood)	Site M (Fermi)	Site N (Belle River)	Site W1 (Port Austin)	Site W2 (Caseville)	Site W3 (Bay Port)
7.6 Utility Displacement/Replacement	3	5	5	5	3	5	5	5	5
7.7 Cogeneration Potential	1	1	1	1	1	3	3	3	3
Weighted Group Total		1.00	0.94	0.94	0.76	0.84	0.84	0.90	1.02
8.0 Transmission System									
8.1 Distance from Transmission	2	3	3	5	5	5	1	1	1
8.2 Transmission System Reliability/Capacity	3	5	5	1	5	3	1	1	1
Weighted Group Total		0.21	0.21	0.13	0.25	0.19	0.05	0.05	0.05
9.0 Transportation									
9.1 Highway Transportation	1	5	5	5	5	5	5	5	5
9.2 Road Displacement/Replacement	1	3	3	5	5	5	3	3	3
Weighted Group Total		0.08	0.08	0.10	0.10	0.10	0.08	0.08	0.08
10.0 Water Resources									
10.1 Adequacy of Water Source	4	5	5	5	5	5	5	1	5
10.2 Distance to Adequate Water Source	4	5	5	3	5	5	5	5	5
10.3 Static Head	2	5	3	3	3	3	3	5	3
10.4 Makeup Water Quality	1	5	5	3	3	3	3	3	3
10.5 Groundwater Quality	1	5	5	3	3	3	3	3	3
10.6 Feasibility of Well Field	1	3	1	1	3	1	3	3	3
Weighted Group Total		0.63	0.57	0.45	0.55	0.53	0.55	0.43	0.55

Table 9.3-3 Evaluation Scores of Candidate Sites (Sheet 4 of 5)

Evaluation Criteria	Weighting Factor, %	Site A (Petersburg)	Site C (South Britton)	Site F (Greenwood)	Site M (Fermi)	Site N (Belle River)	Site W1 (Port Austin)	Site W2 (Caseville)	Site W3 (Bay Port)
11.0 Security Considerations									
11.1 Security Considerations	5	3	3	3	1	1	1	3	1
Weighted Group Total		0.15	0.15	0.15	0.05	0.05	0.05	0.15	0.05
12.0 Development Costs									
12.1 Water Supply	2	1	1	3	5	1	5	1	5
12.2 Linear Facilities	2	1	1	3	3	3	1	1	1
12.3 Transmission System	2	1	1	3	3	3	1	1	1
12.4 Cooling Towers	2	1	1	1	1	1	1	1	1
12.5 Fuel Transport	2	3	3	5	5	5	1	1	1
Weighted Group Total		0.14	0.14	0.30	0.34	0.26	0.18	0.10	0.18
13.0 Waste Disposal									
13.1 Dry Spent Fuel Storage Capacity	2	5	5	5	3	5	5	5	5
Weighted Group Total		0.10	0.10	0.10	0.06	0.10	0.10	0.10	0.10
Weighted Technical Total	59	2.31	2.19	2.17	2.11	2.07	1.85	1.81	2.03
Weighted Total	100	3.44	3.34	3.56	3.86	3.70	2.72	2.90	3.12

Table 9.3-3 Evaluation Scores of Candidate Sites (Sheet 5 of 5)

Sensitivity Analyses Results

Site	Technical Score	Environmental Score	Base Case	Technical Emphasis	Environmental Emphasis	Average
A	2.27	1.13	3.40	3.52	3.03	3.35
C	2.11	1.15	3.26	3.34	2.97	3.25
F	2.17	1.39	3.56	3.59	3.24	3.46
M	2.08	1.65	3.73	3.68	3.62	3.75
N	2.03	1.63	3.66	3.60	3.45	3.60
W1	1.85	0.87	2.72	2.83	2.39	2.65
W2	1.73	0.97	2.70	2.76	2.62	2.82
W3	2.03	0.97	3.00	3.12	2.78	3.03

Table 9.3-4 Ranking of the Candidate Sites

Site	County	Notes	Rank
M	Monroe	Fermi	1
N	St. Clair	Belle River/St. Clair	2
F	St. Clair	Greenwood	3
A	Monroe	Greenfield	4
C	Lenawee	Greenfield	5
W3	Huron	Greenfield	6
W2	Huron	Greenfield	7
W1	Huron	Greenfield	8

Figure 9.3-1 Site Selection Methodology Flow Chart

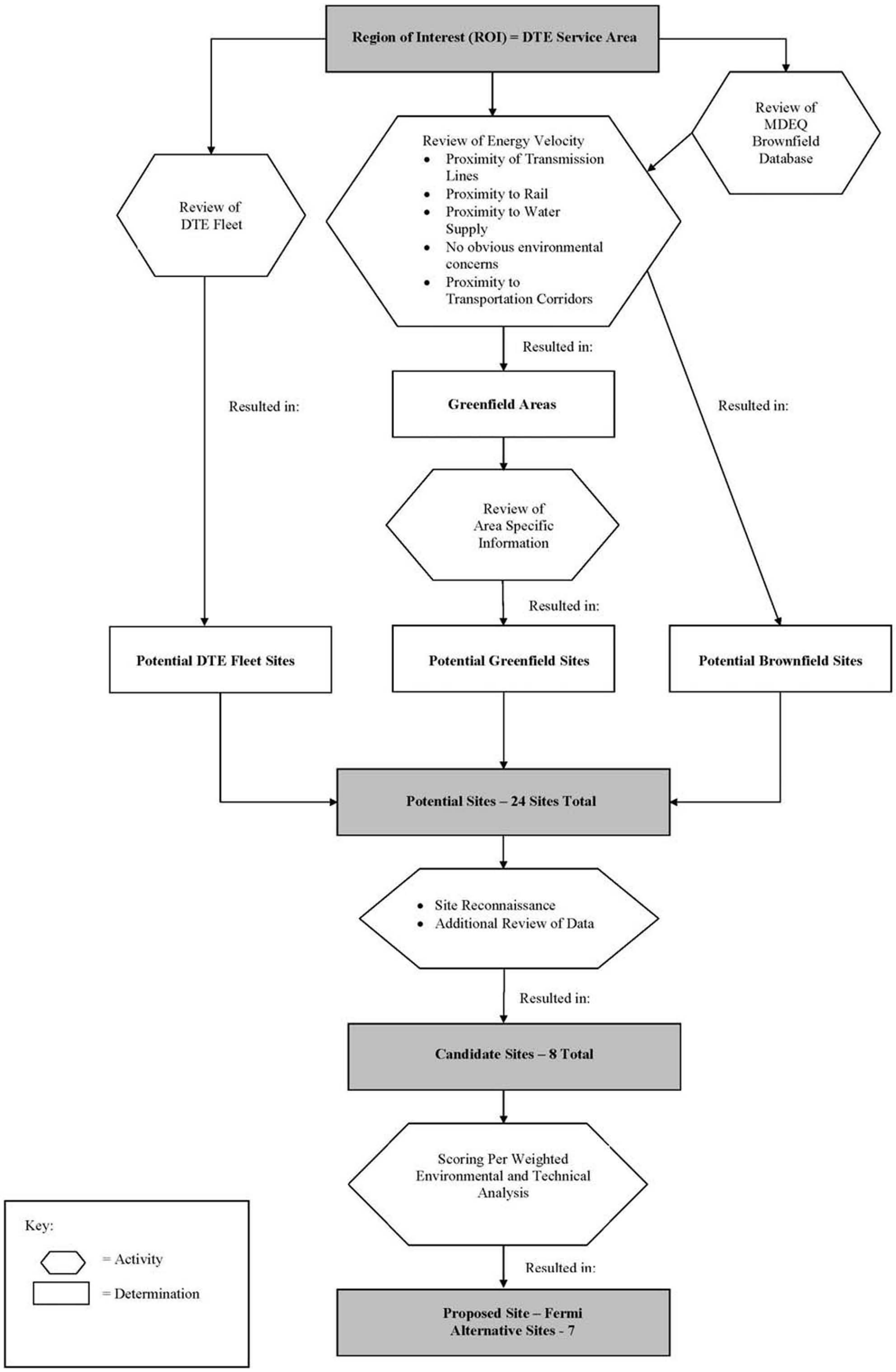


Figure 9.3-2 Michigan Service Area

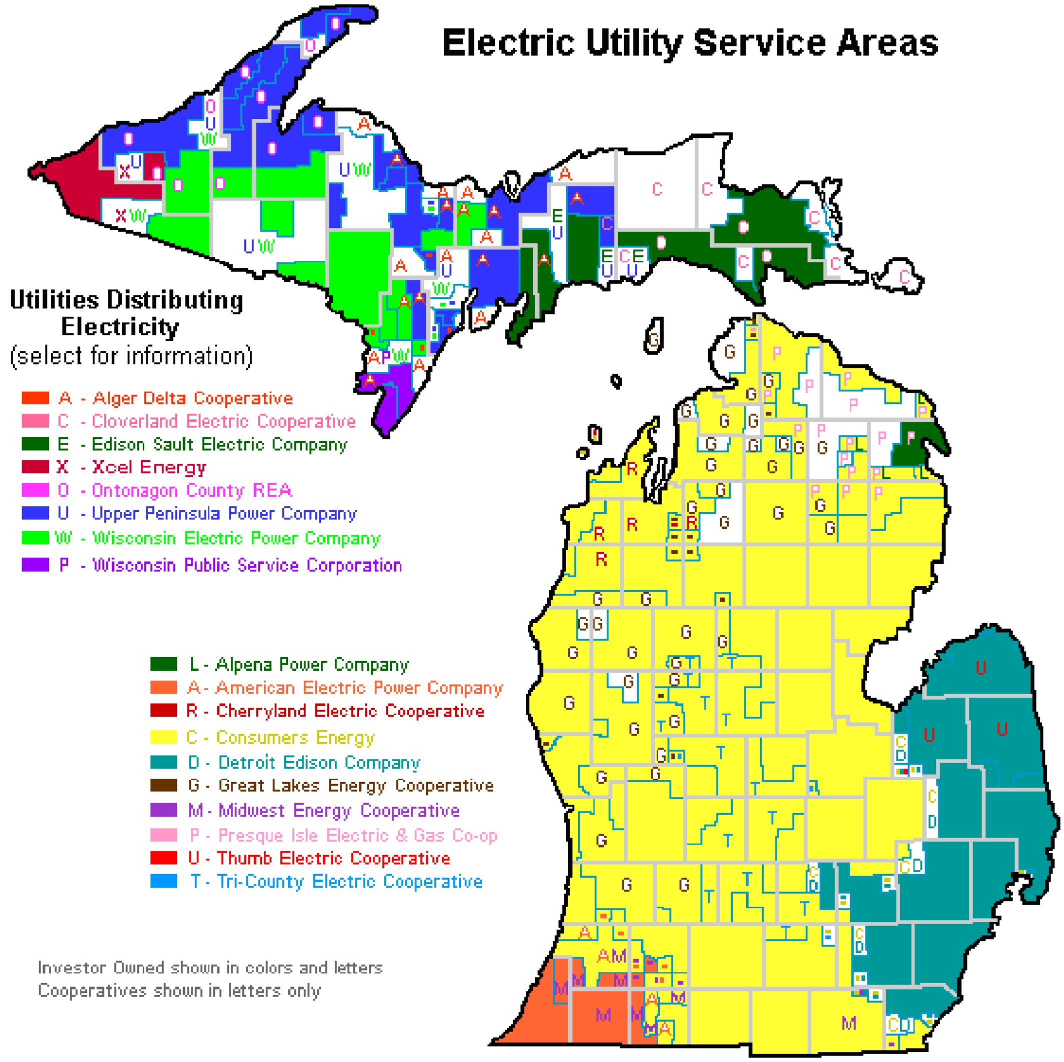


Figure 9.3-3 Detroit Edison Service Area

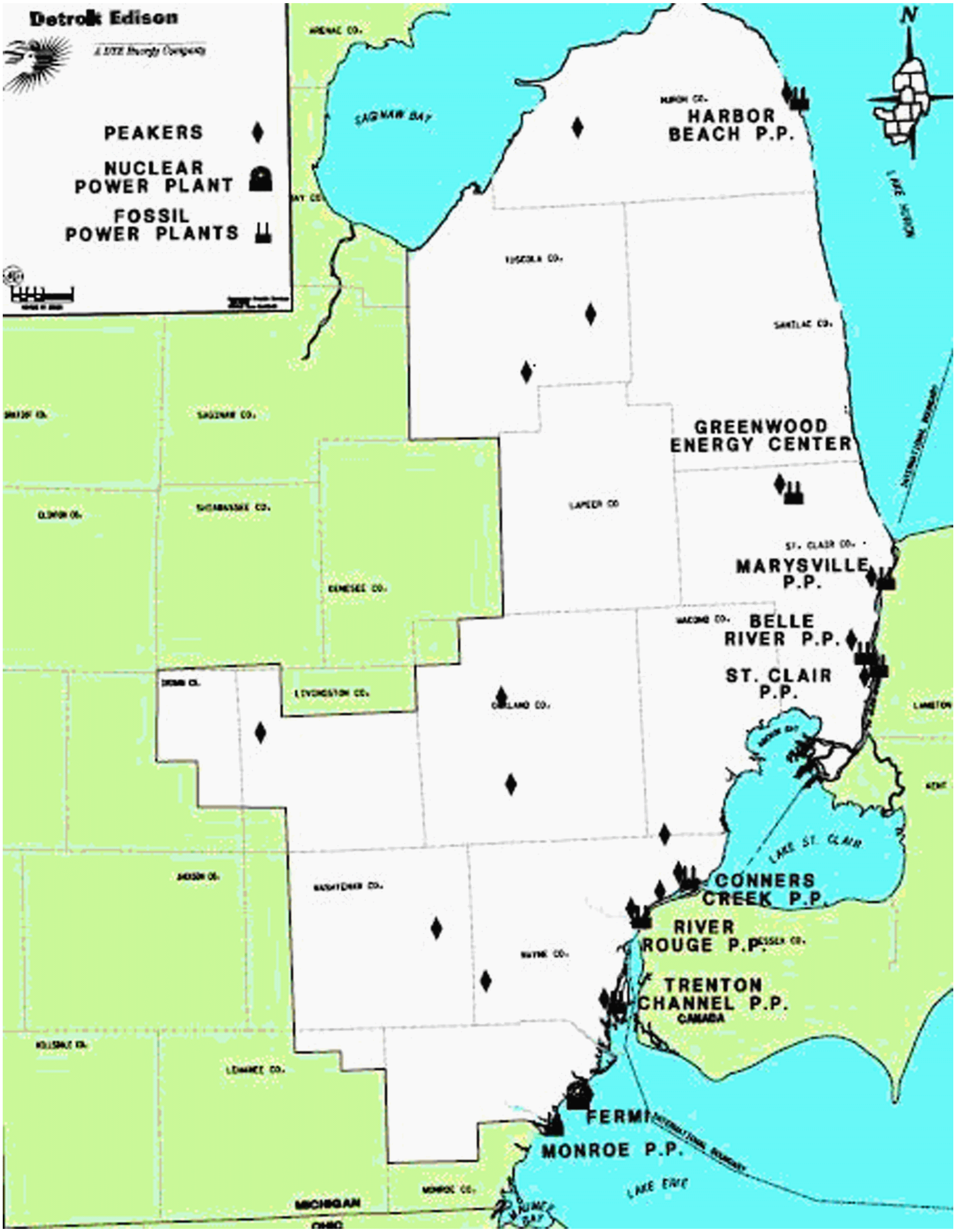


Figure 9.3-4 Potential Sites

Key

= Potential Site

Figure 9.3-5 Candidate Sites

Key
= Proposed Site
= Alternative Sites

Figure 9.3-6 Land Use Within the 7.5 Mile Vicinity of Site F (Greenwood)

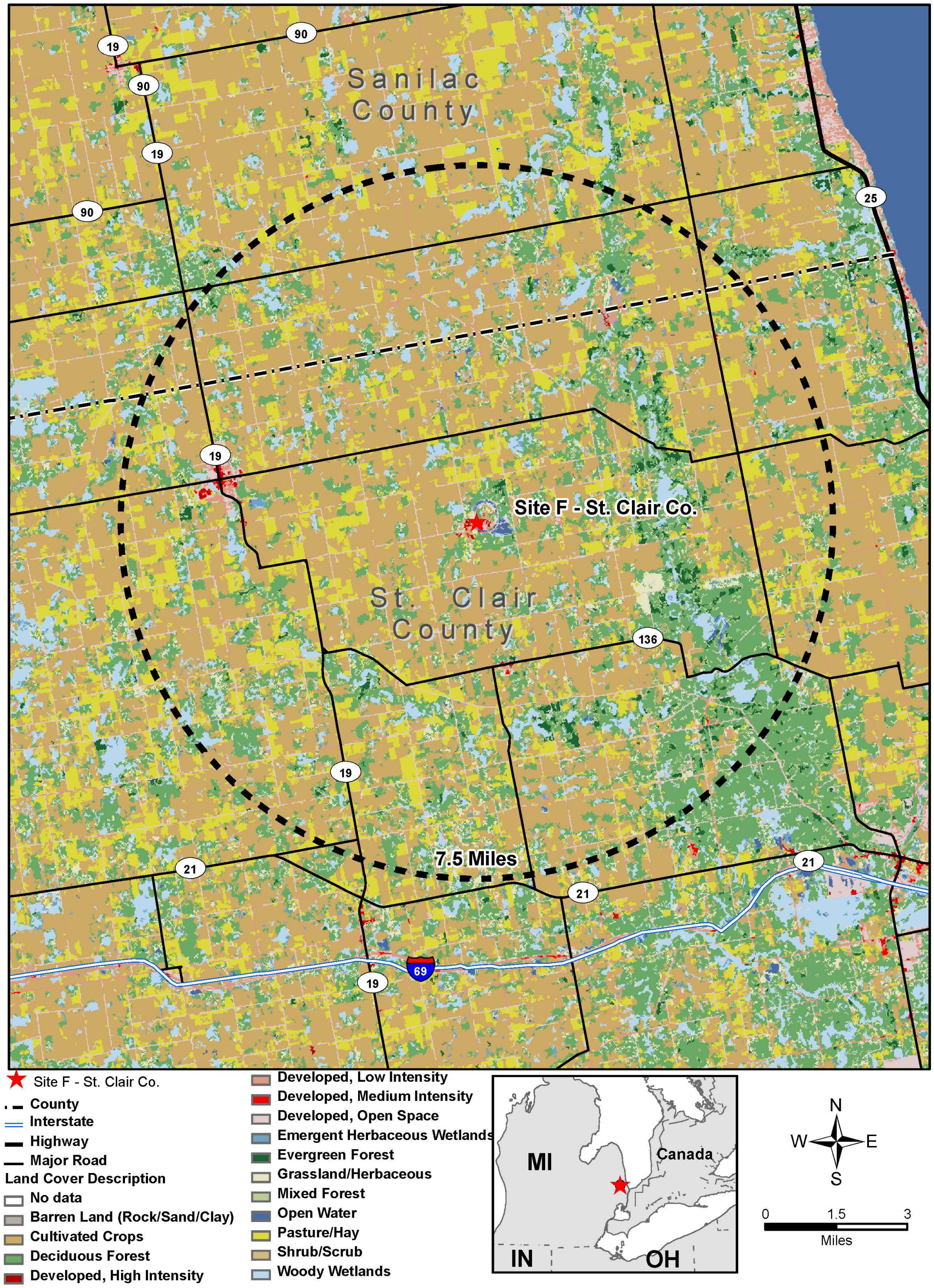


Figure 9.3-7 Utility Infrastructure Within the 7.5 Mile Vicinity of Site F (Greenwood)

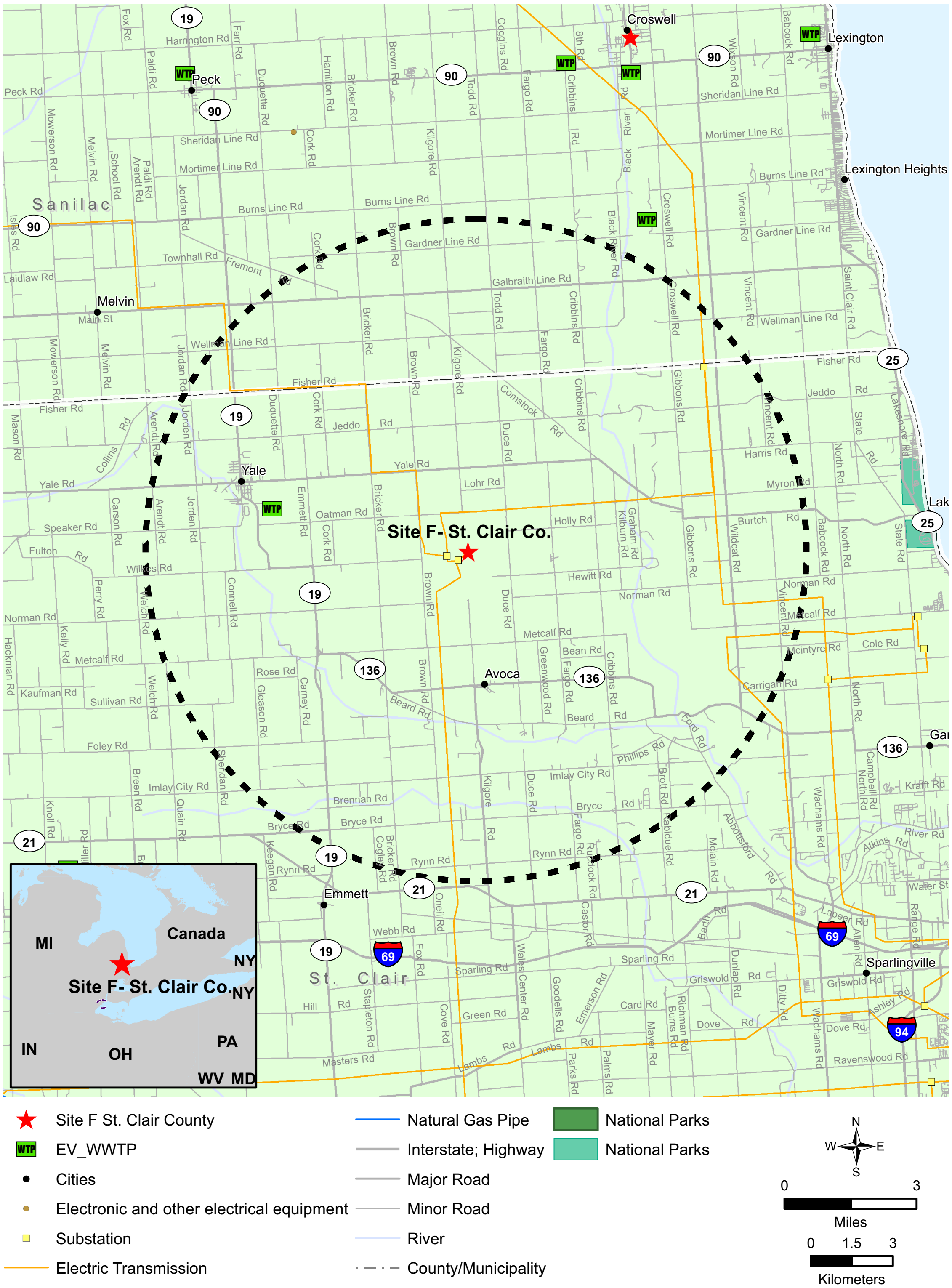


Figure 9.3-8 Land Use Within the 7.5 Mile Vicinity of Site A (Petersburg)

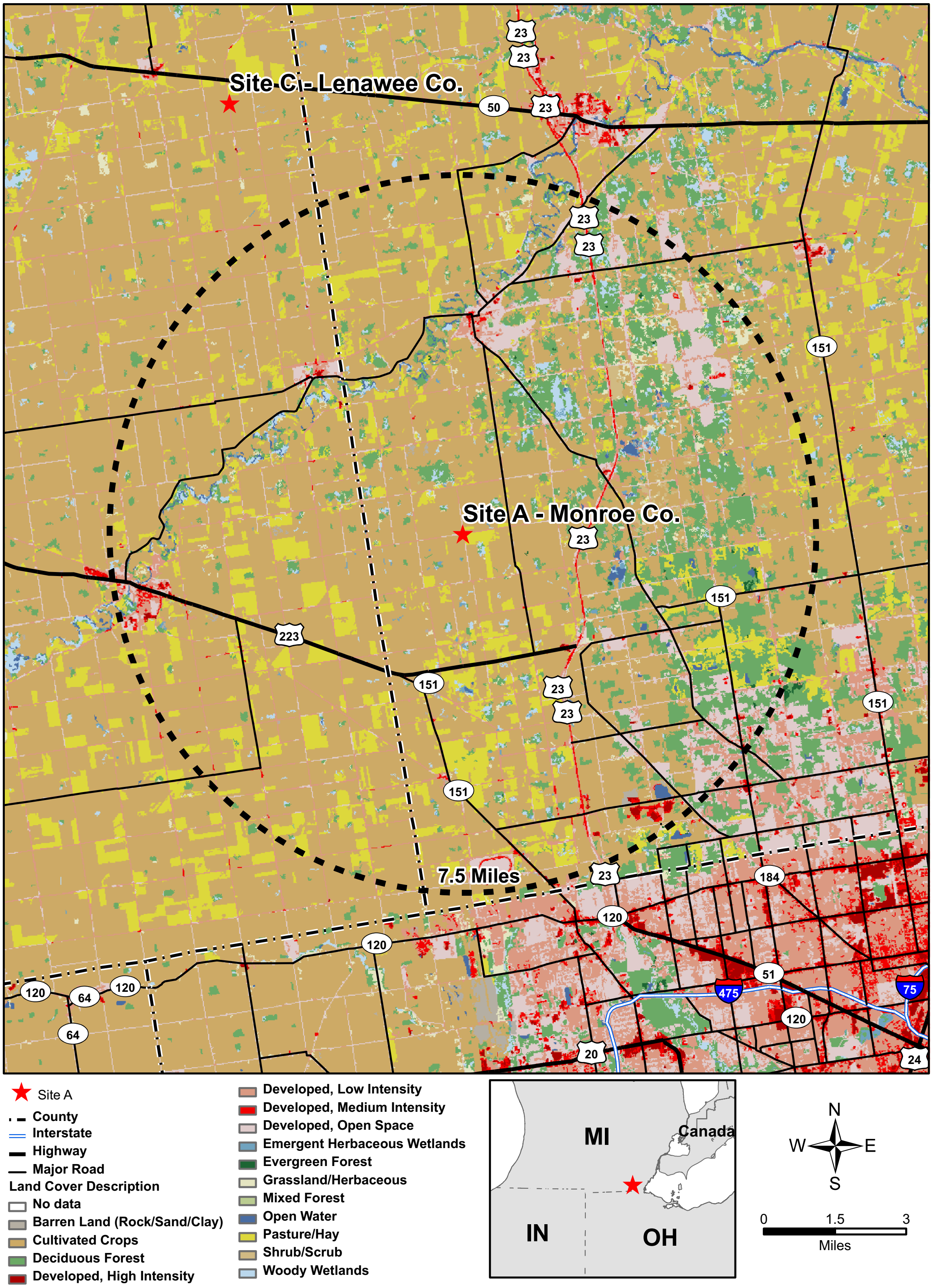


Figure 9.3-9 Utility Infrastructure Within 7.5 Mile Vicinity of Site A (Petersburg)

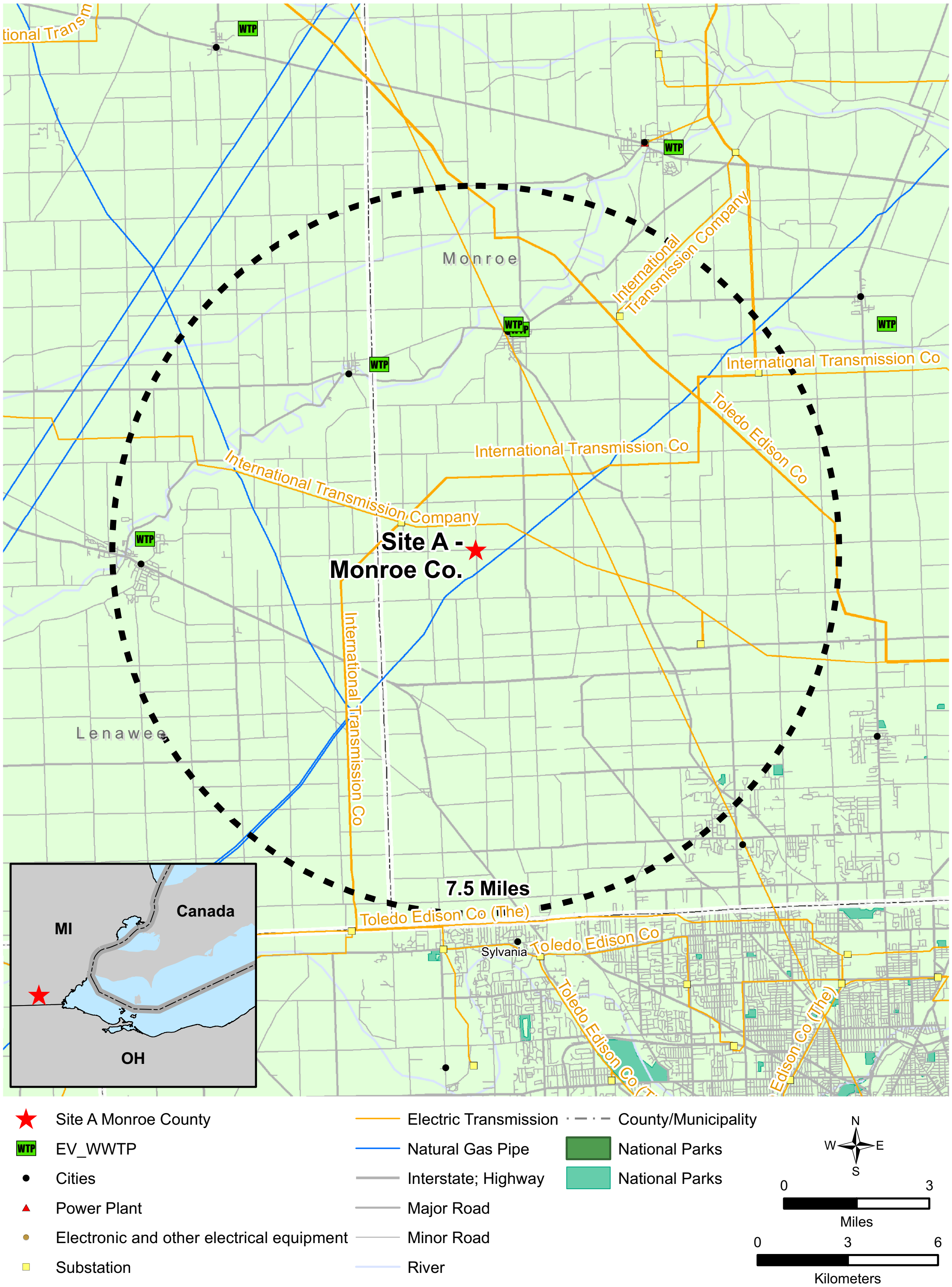


Figure 9.3-10 Land Use Within the 7.5 Mile Vicinity of Site C (South Britton)

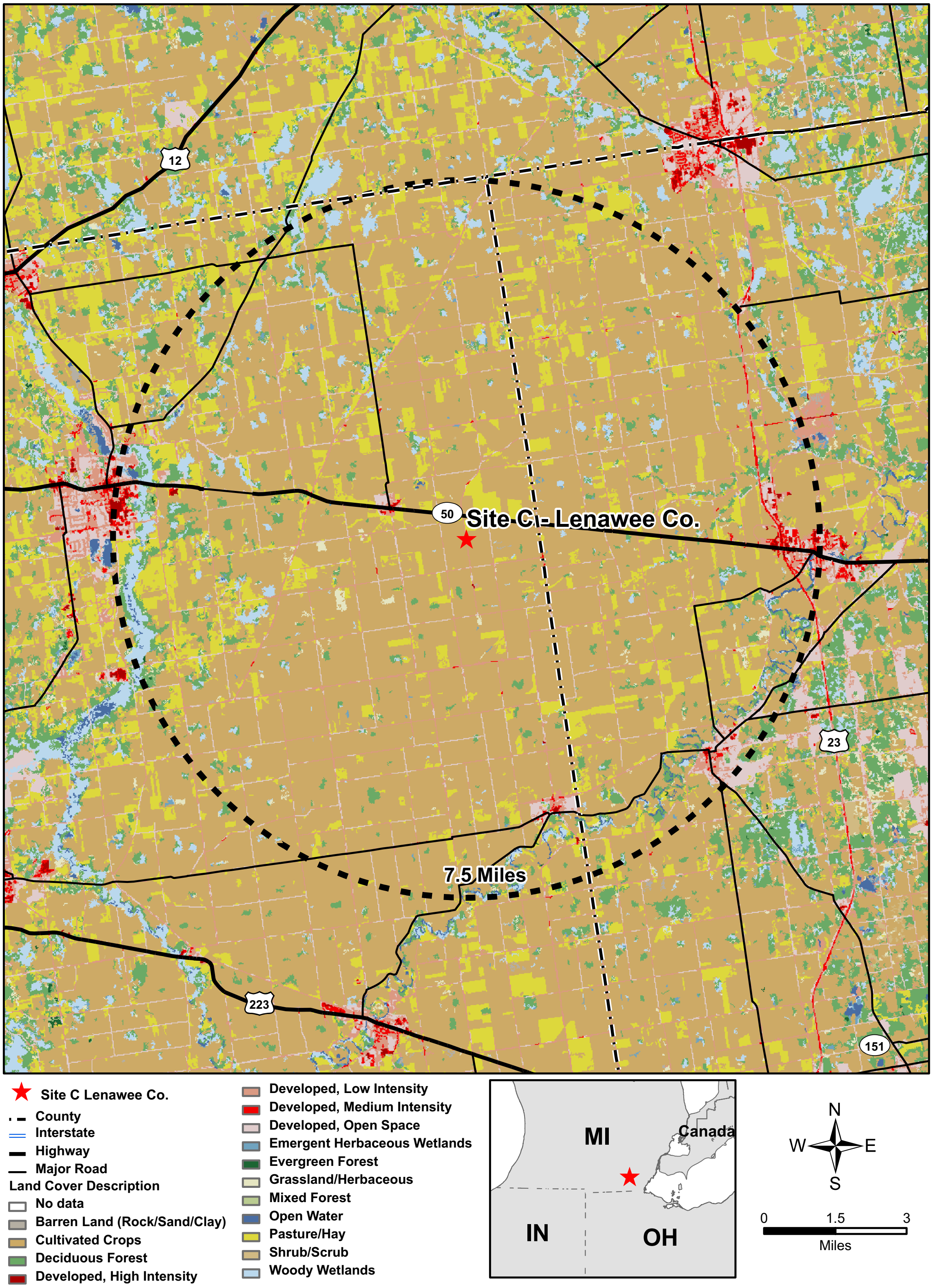


Figure 9.3-11 Utility Infrastructure Within the 7.5 Mile Vicinity of Site C (South Britton)

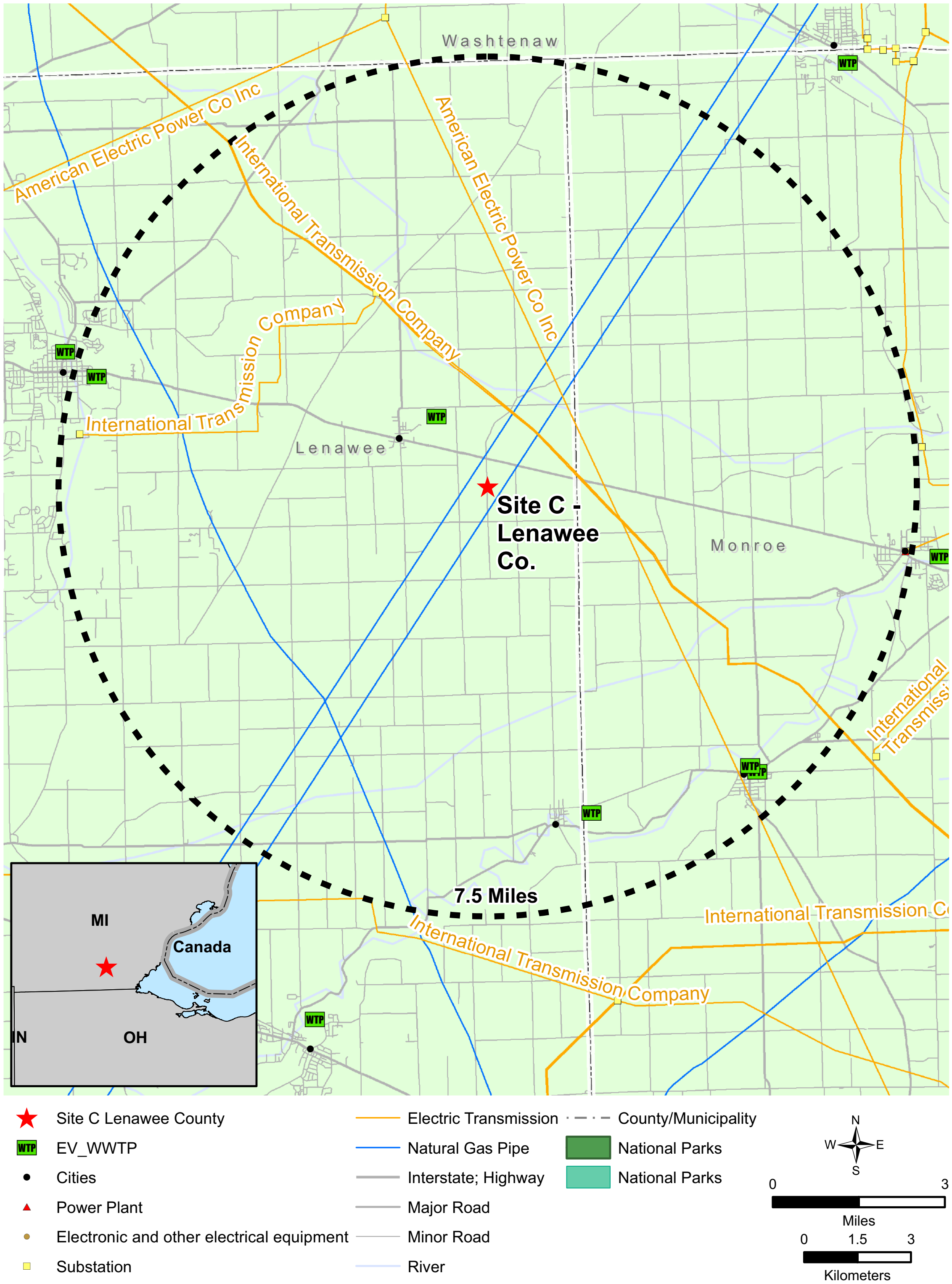


Figure 9.3-12 Land Use Within the 7.5 Mile Vicinity of Site N (Belle River)

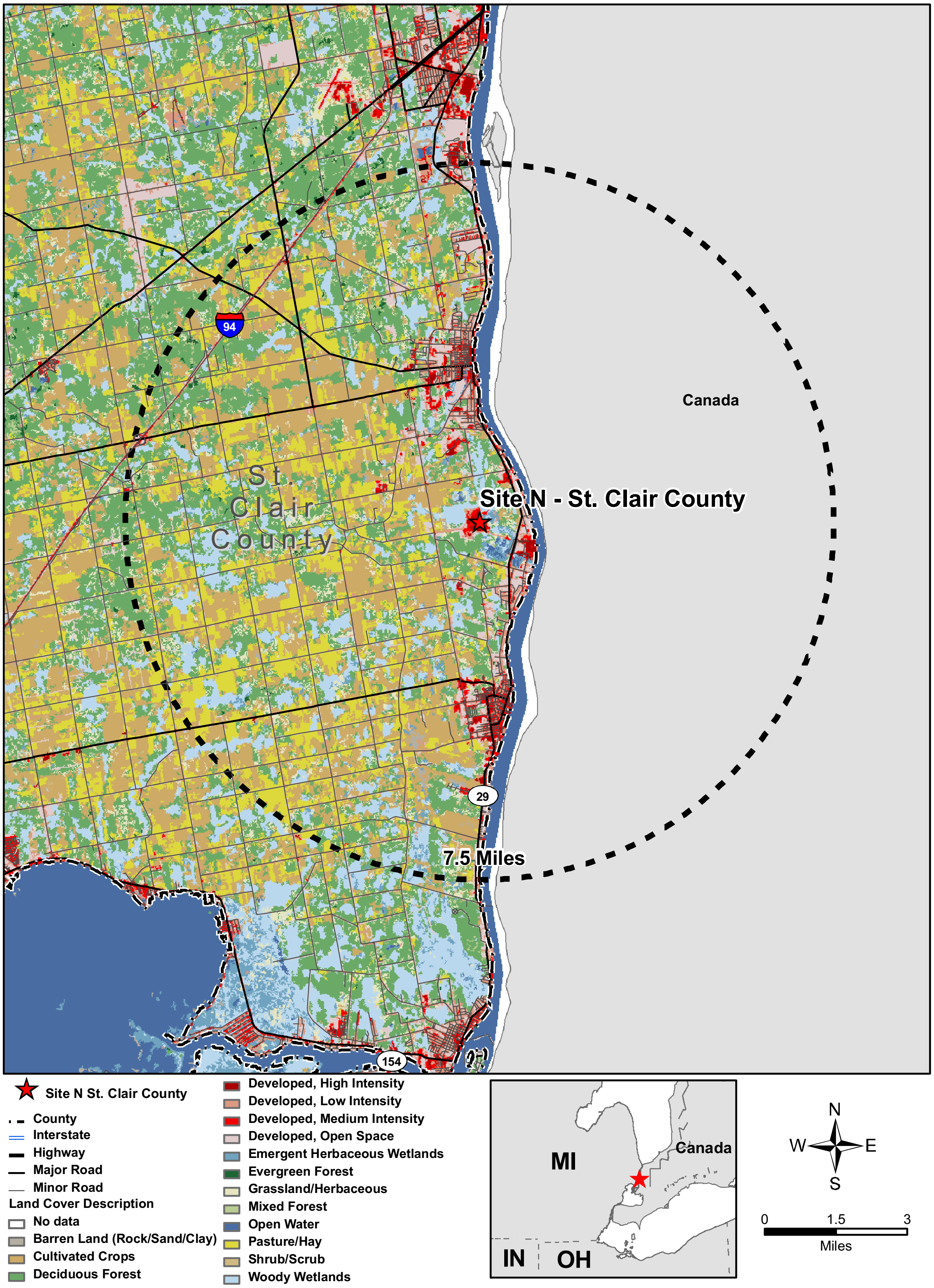


Figure 9.3-13 Utility Infrastructure Within the 7.5 Mile Vicinity of Site N (Belle River)

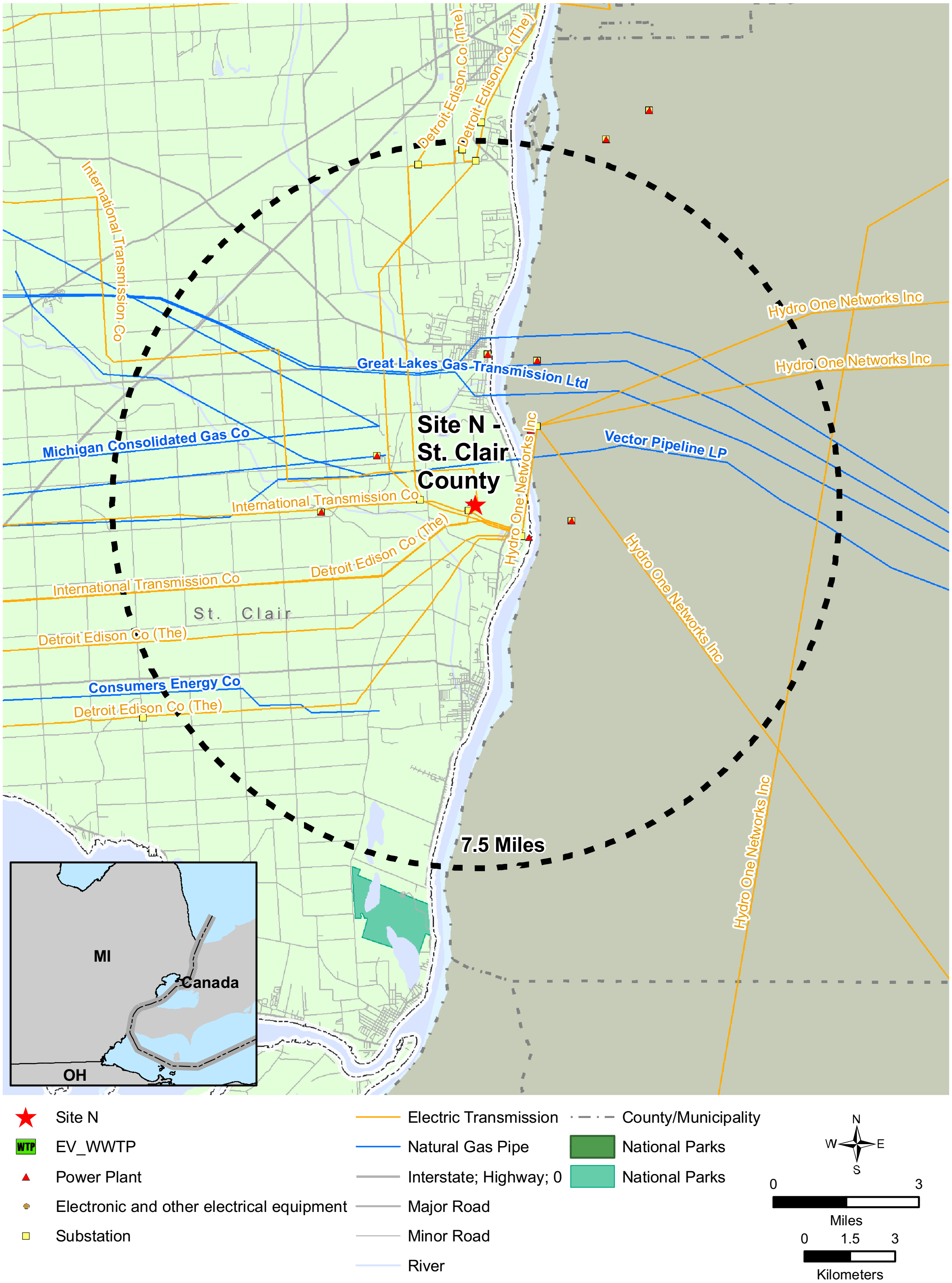


Figure 9.3-14 Land Use Within the 7.5 Mile Vicinity of Site W1 (Port Austin)

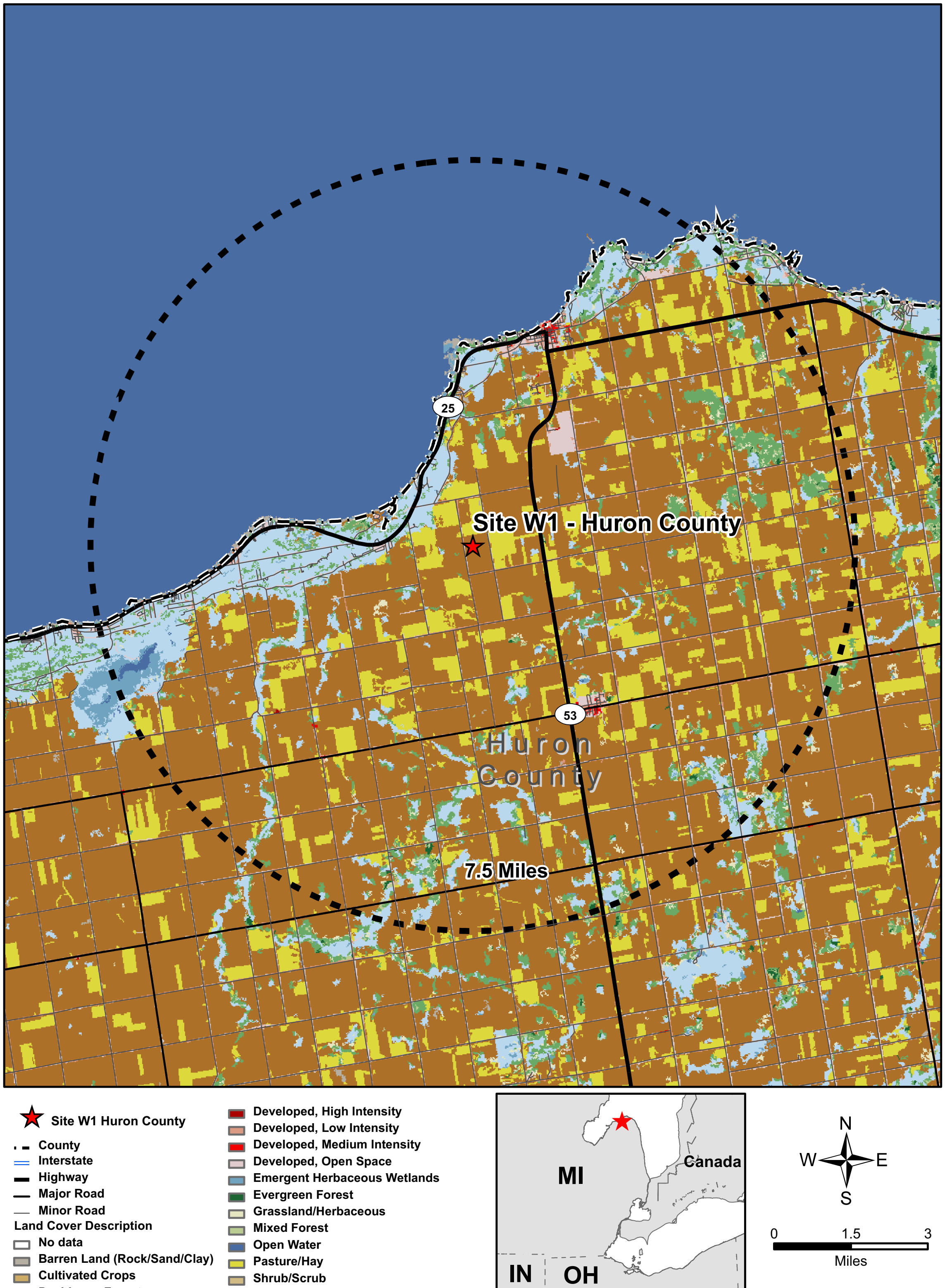


Figure 9.3-15 Utility Infrastructure Within the 7.5 Mile Vicinity of Site W1 (Port Austin)

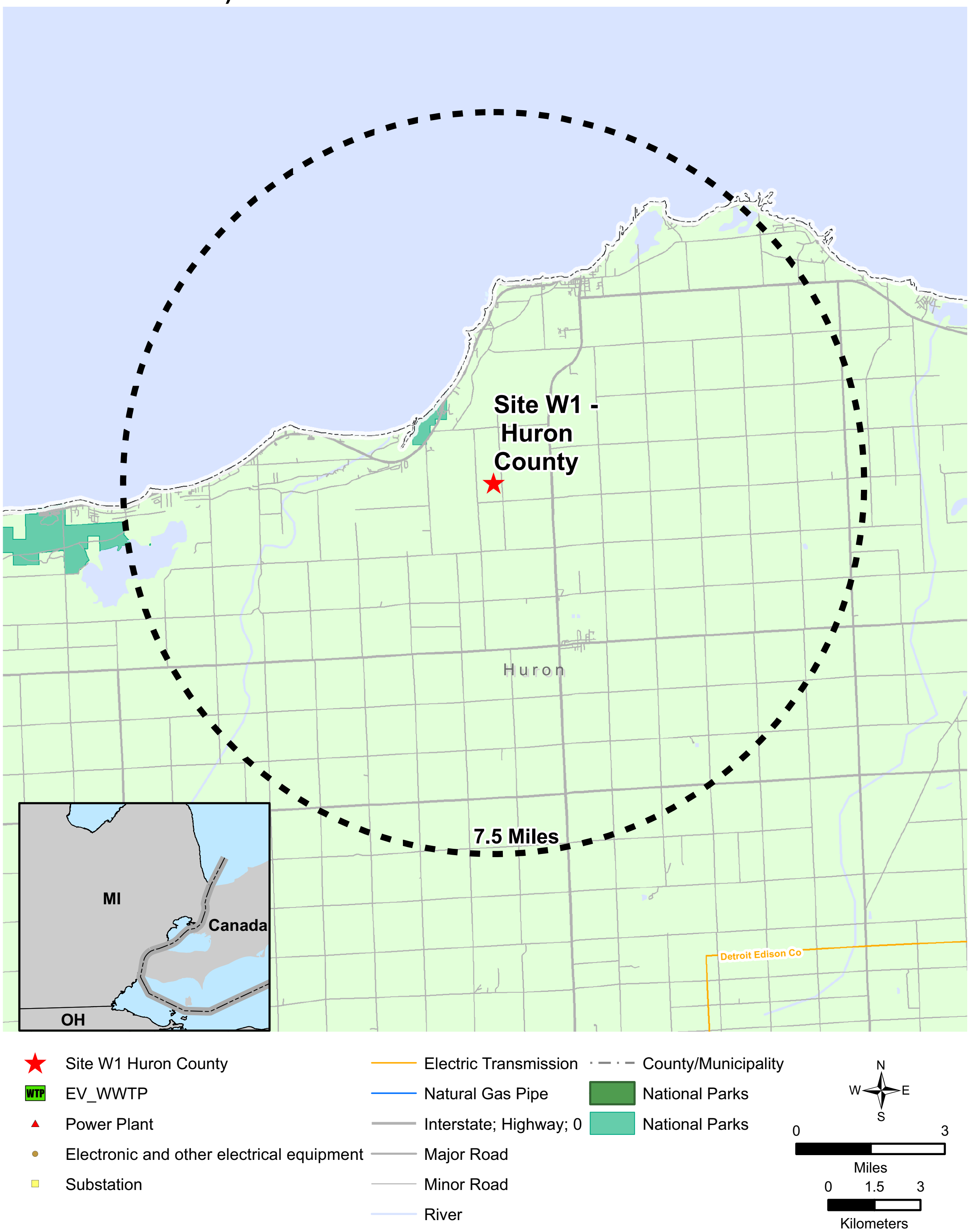


Figure 9.3-16 Land Use Within the 7.5 Mile Vicinity of Site W2 (Caseville)

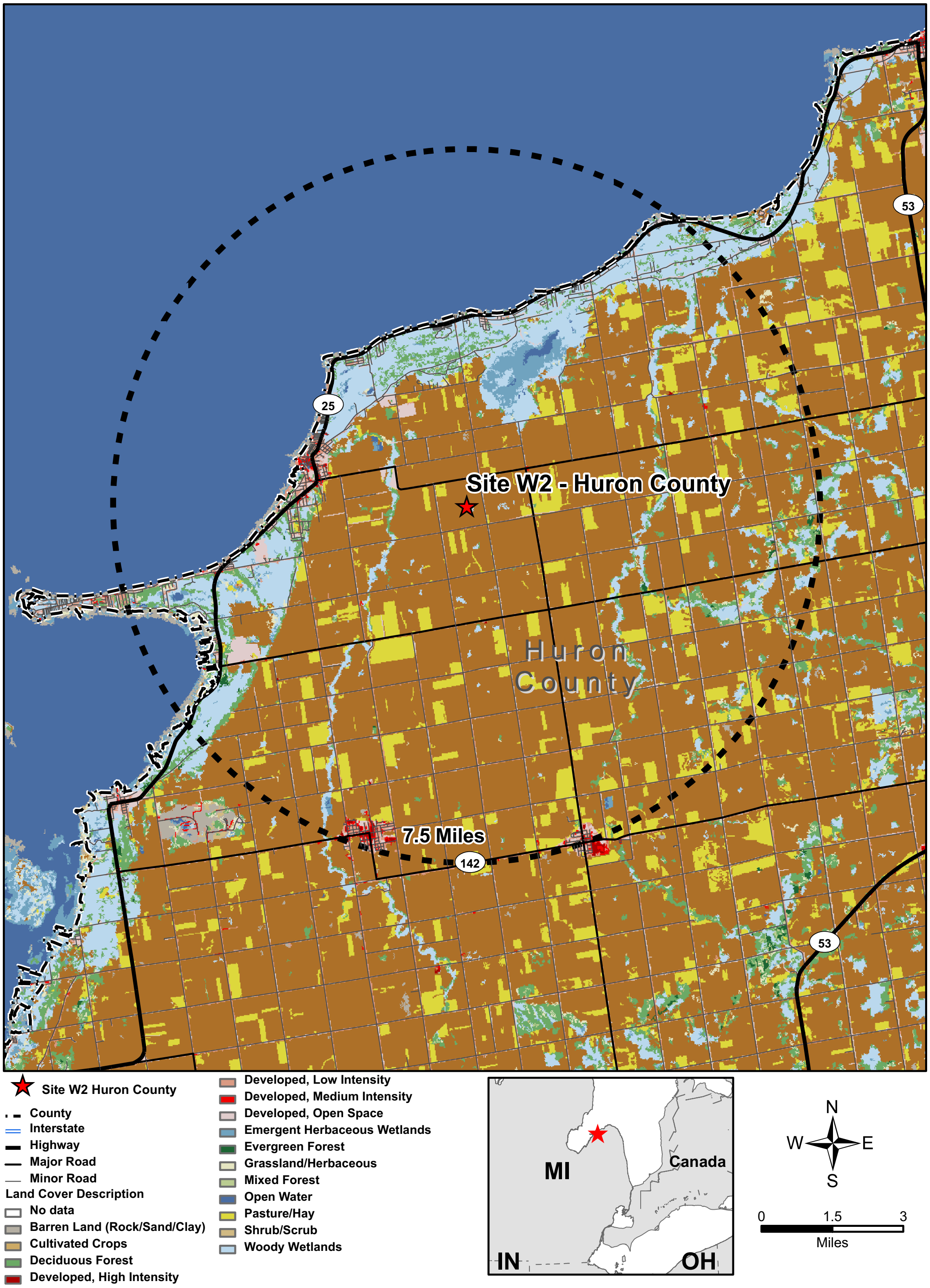


Figure 9.3-17 Utility Infrastructure Within the 7.5 Mile Vicinity of Site W2 (Caseville)

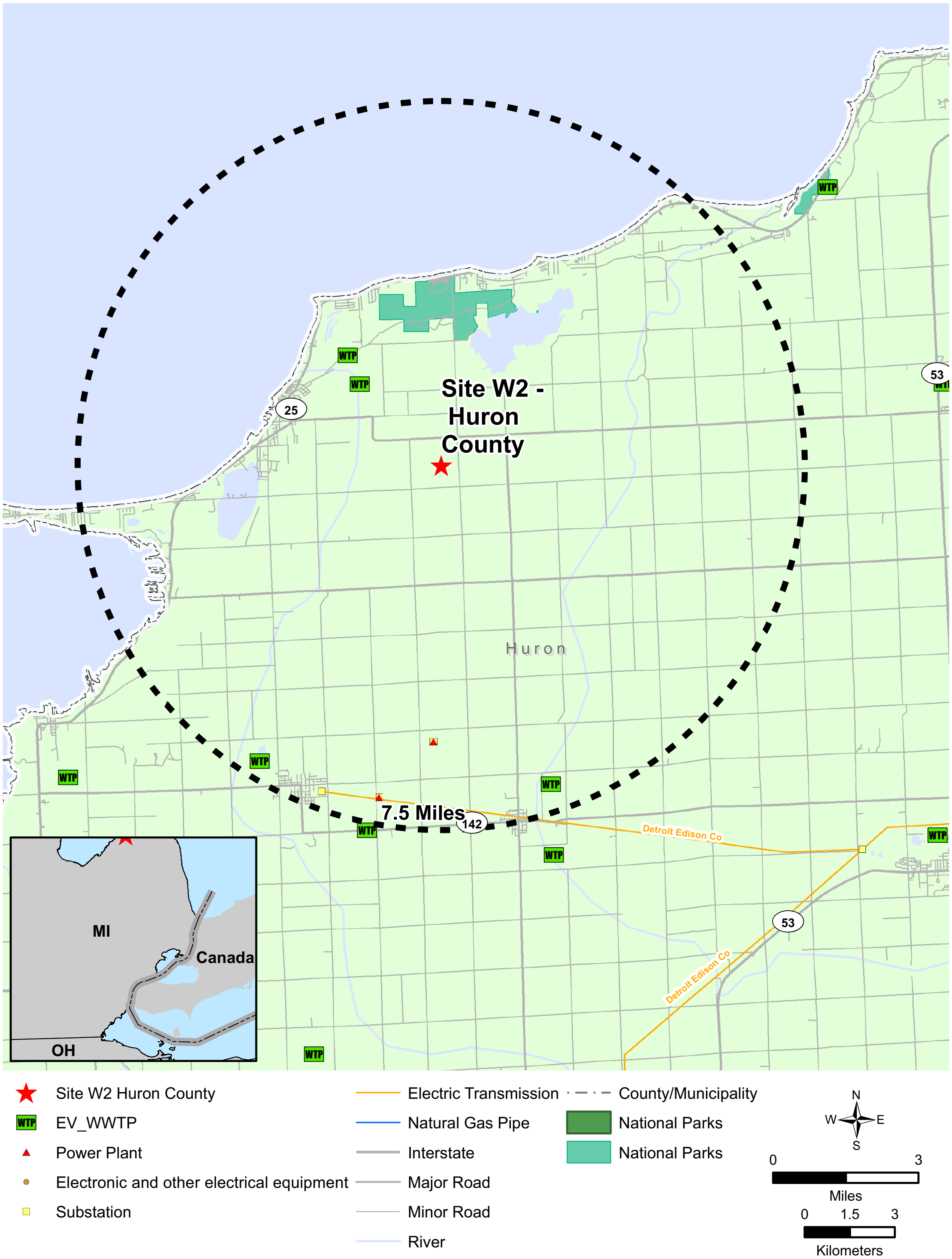


Figure 9.3-18 Land Use Within the 7.5 Mile Vicinity of Site W3 (Bay Port)

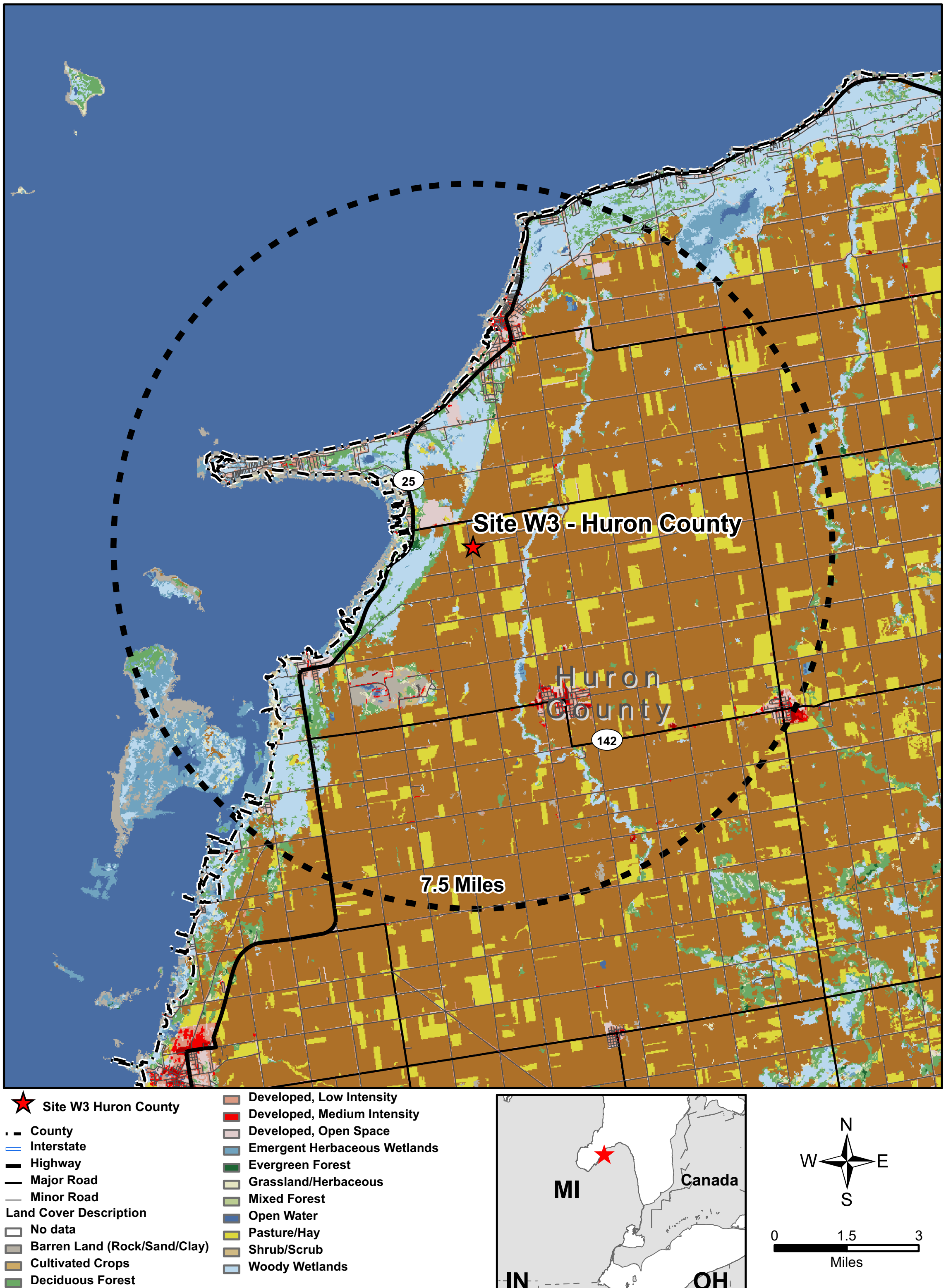
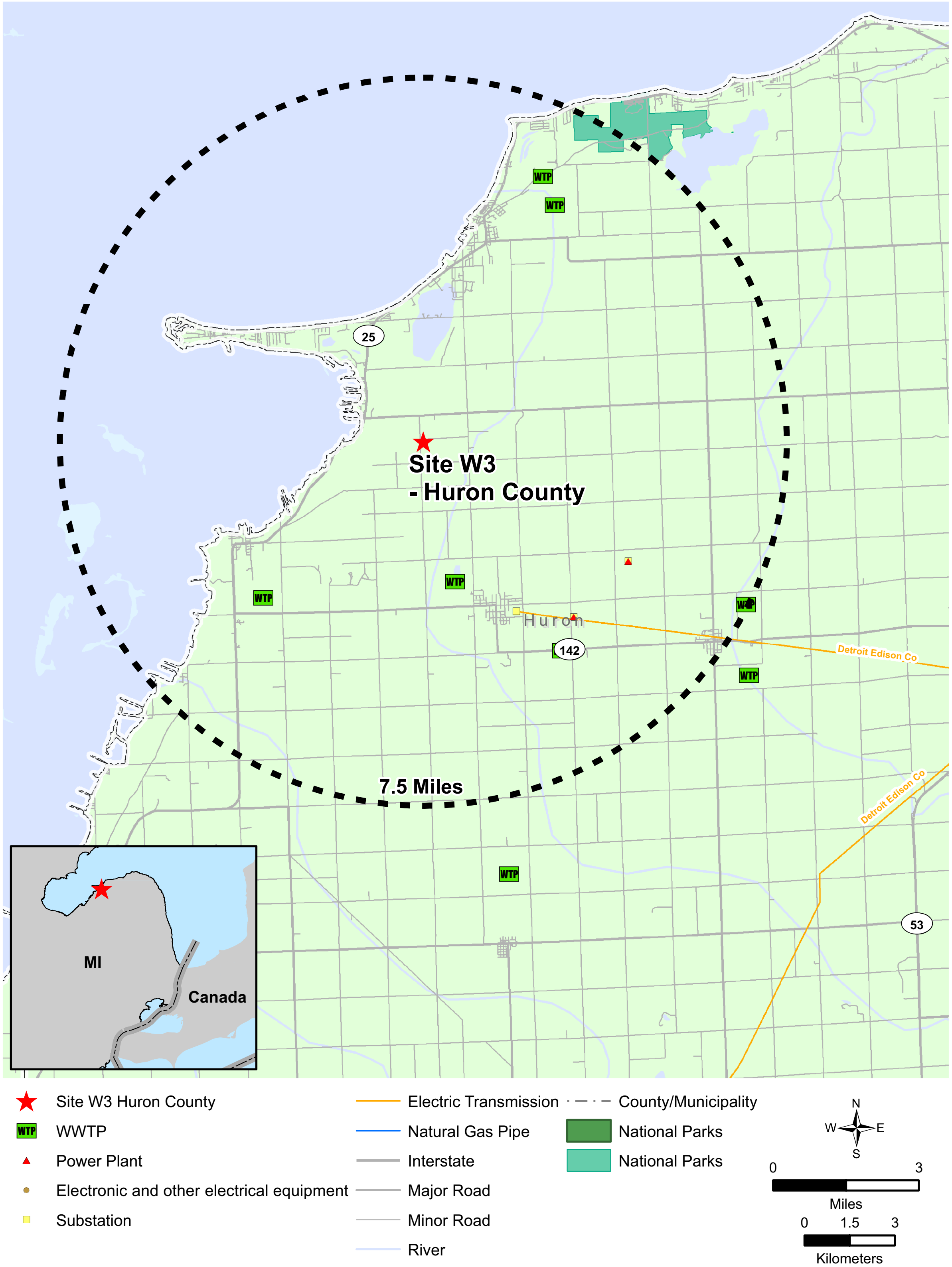


Figure 9.3-19 Utility Infrastructure Within the 7.5 Mile Vicinity of Site W3 (Bay Port)



9.4 Alternative Plant and Transmission Systems

This section discusses alternative plant and transmission systems for Fermi 3. Subsection 9.4.1 evaluates alternative heat dissipation systems, Subsection 9.4.2 evaluates alternative circulating water systems, and Subsection 9.4.3 evaluates alternative transmission systems. This evaluation of alternatives includes comparison with the proposed system to identify those systems that are environmentally preferable and environmentally equivalent to the proposed system. If any alternative is identified as environmentally preferable, it is compared with the proposed system on a benefit-cost basis to determine if any such system should be considered as a preferred alternative to the proposed system.

9.4.1 **Heat Dissipation Systems**

This evaluation focuses on identifying alternative heat dissipation systems that are feasible, legislatively compliant, and environmentally preferable. In accordance with NUREG-1555, this evaluation first compares these alternatives with the proposed system using standardized criteria that include land use, water use, thermal and physical impacts, atmospheric effects, noise generation, aesthetics and recreational benefits, generating efficiency, and operating and maintenance experience with similar units.

The proposed system and alternatives that prove to be feasible, legislatively compliant, and environmentally preferable have been economically evaluated. There are no mitigating measures in Chapter 4 or Chapter 5 for the proposed heat dissipation system that warrant consideration in this evaluation.

9.4.1.1 **Screening of Alternative Heat Dissipation Systems**

Heat from Fermi 3 is dissipated by one independent system. The Base Case for Fermi 3 is a closed-cycle system with a natural draft cooling tower (NDCT). Associated intake/discharge structure, pumps, and piping systems are required. Cooled water from the tower is pumped first through the condenser, where it is heated. The heated water is then circulated through the NDCT where heat is rejected to ambient air. Make-up water is obtained from Lake Erie, and cooling tower blowdown is discharged to the lake. The Fermi 3 Base Case system is compared with the following heat dissipation alternatives:

- Once-through system (Alternative 1): This alternative would include a once-through system with its intake and pumping system on Lake Erie, and discharges into Lake Erie.
- Once-through system with helper tower (Alternative 2): This alternative would include the once-through system and a small multi-cell mechanical draft cooling tower system. The helper tower would operate on an as-needed basis during the warmest summer months to mitigate the peak temperatures in Lake Erie by transferring heat to the environment via evaporation, and directly to the atmosphere. Water would be withdrawn from Lake Erie and cooling tower blowdown would be returned to the lake.
- Dry and wet cooling tower system (Alternative 3): This alternative would consist of a combination of dry and wet mechanical draft towers and associated intake/discharge, pumping, and piping systems. The dry cooling tower would consist of a series of moderate

profile, rectangular structures that house large fans and piping, and the wet cooling towers would consist of a series of multi-cell, rectangular cooling tower banks. This closed-cooling system would withdraw water from Lake Erie and transfer heat to the environment via evaporation and directly to the atmosphere. Minor cooling tower blowdown discharges would be released to Lake Erie.

- Mechanical draft cooling tower system (Alternative 4): This alternative would consist of four multi-cell, rectangular cooling tower banks and associated intake/discharge, pumping, and piping systems. This closed-cooling system would withdraw water from Lake Erie and transfer heat to the environment via evaporation and directly to the atmosphere. Comparable cooling tower blowdown discharges would be released to the lake.
- Spray ponds (Alternative 5): This alternative would involve the addition of new surface water bodies on site and the addition of an extensive matrix of spray modules to promote evaporative cooling in the new ponds. Additional pumping and piping systems would be required.
- Dry tower system (Alternative 6): This alternative would consist of a series of moderate profile (approximately 150-foot high) rectangular structures that house large fans and piping. There would be few other resources required (e.g., water, wastewater) besides land.

9.4.1.1.1 **Technical, Regulatory, and Environmental Review of Heat Dissipation Systems**

The Fermi 3 Base Case and alternative heat dissipation systems are screened and compared in Table 9.4-1. These tables present consideration of land and water use, as well as other environmental criteria, regulatory restrictions, and operating and maintenance factors.

The Fermi 3 evaluation concludes that the following heat dissipation systems are feasible, legislatively compliant, and environmentally preferable or equivalent to the Base Case:

- Dry and wet cooling tower system (Alternative 3)
- Mechanical draft cooling tower system (Alternative 4)
- Dry towers (Alternative 6)

The once-through system (Alternative 1), once-through system with helper tower (Alternative 2) and the spray pond system (Alternative 5) posed regulatory approval barriers, as presented in Table 9.4-1, and therefore have been removed from further consideration.

9.4.1.1.2 **Thermal Impact and Water Level Enhancements**

As demonstrated in previous sections, Lake Erie would dissipate the negligible waste heat from the continuous blowdown of Fermi 3 wet towers. Because blowdown is taken from water already cooled in the towers, any additional waste heat to Lake Erie is negligible.

9.4.1.2 **Analysis of Alternative Heat Dissipation Systems**

In addition to the screening performed in Table 9.4-1, analysis of economic factors is performed in Table 9.4-2. A summary of the previous screening is also shown in Table 9.4-2.

9.4.1.2.1 **Relative Economic Evaluation of Heat Dissipation Systems**

The Fermi 3 capital costs would be the highest for dry towers (Alternative 6). The capital cost for alternatives using wet cooling towers (Alternatives 3 and 4), including the Base Case, would be lower than dry towers. The operating costs of wet cooling tower alternatives, including the Base Case, are lower than dry towers (Alternative 6), primarily because dry tower fans use more power. There is a brief summary of this information included in Table 9.4-2.

9.4.1.2.2 **Alternative Heat Dissipation System Summary**

Table 9.4-2 offers a summary comparison of the relative natural resource (i.e., land, water) requirements, environmental impacts, regulatory barriers, operating issues, and energy/economic considerations for the Base Case and the alternative heat dissipation systems for Fermi 3. This table identifies the closed-cycle, natural draft cooling tower system (Base Case) as the preferred cooling system option because of its advantages from regulatory, water usage, and thermal impact perspectives. The other wet and dry tower systems (Alternatives 3, 4 and 6) scored lower on key attributes than the Base Case. However, these alternatives did not present any fatal flaws, and thus, these alternatives were also deemed appropriate for further energy and economic review. The once-through cooling systems (Alternatives 1 and 2) offer advantages with respect to land use, aesthetics (no visual impact or noise), good operating experience, and low impact on generating efficiency. However, significant hydrology related concerns were identified for the once-through systems. Specifically, these hydrology concerns are related to a high water use from Lake Erie, thermal and physical impacts in Lake Erie due to the discharge water flow rate and temperature, and the associated potential regulatory barriers. Based on these issues, the once through designs (Alternatives 1 and 2) were eliminated from further consideration. The cooling pond system (Alternative 5) potentially provides good performance in areas of air use and noise generated. However, concerns with Alternative 5 were identified related to significant land use requirements, significant water use, and the associated potential regulatory barriers. Based on these issues, the cooling pond system (Alternative 5) was eliminated from further consideration. Therefore, from the perspective of natural resource requirements, environmental impacts, regulatory barriers, and operating issues, the Base Case and Alternatives 3, 4 and 6 were retained for further economic evaluation.

Subsequent cost comparisons show that the capital and operating costs of dry towers would be higher than wet towers. The lower efficiency of the dry tower system represents a significant increase in fuel requirements over the lifetime of the plant. In addition, evaluations show that the all-dry system (three-thirds dry cooling capacity) material cost is more than 500 percent higher than a one-third minimum dry cooling capacity system and the dry system contains significantly more active components, which would increase maintenance costs. Also, the dry tower system alone is unable to produce the needed performance required during periods of high ambient dry bulb temperature, which could occur during the summer season, without having periods of power reduction. Thus, a partially or fully wet cooling tower system is required to lower the cooling water temperature sufficiently to operate the plant without a reduction in unit power output. Dry cooling towers can require as much as 10 times the area of a wet tower with a comparable cooling capacity, depending on the technology selected. Because of its thermal performance limitations when air ambient temperature is high, a dry tower array would become very large, using significant acreage, and could have a higher profile.

9.4.2 Circulating Water Systems

As presented in Subsection 9.4.1, the proposed heat dissipation system for Fermi 3 is a closed-cycle, natural draft cooling tower. Since the proposed system for Fermi 3 is not an open-loop circulating water system, there is no need to evaluate circulating water system alternatives. The closed-loop system is a preferable alternative due largely to water conservation. The closed-loop circulating water system for Fermi 3 would, however, require continuous make-up water to the cooling tower basin to compensate for the evaporative losses and cooling tower blowdown. This evaluation focuses on identifying feasible make-up water intake systems that are legislatively compliant, environmentally preferable, and economically viable. In accordance with NUREG-1555 guidance, this evaluation first compares alternative intake water systems against the Base Case system using standardized criteria that include construction impacts, aquatic issues, water use, land use, and compliance with regulations. As stated in NUREG-1555, the proposed system and alternatives that prove to be feasible, legislatively compliant, and environmentally preferable are then evaluated on an economic basis.

The Base Case make-up water intake system for Fermi 3 comprises:

- Intake System: Shoreline
- Intake Location: Adjacent to existing intake structure on Lake Erie
- Discharge System: Offshore
- Discharge Location: Offshore pipe routing adjacent to the intake structure
- Water Supply: Lake Erie
- Water Treatment: Chemical biocide/corrosion/antiscalant treatment/dehalogenation

The following subsections evaluate this Base Case against a list of potential alternative system components that address intake, discharge, water supply, and water treatment issues for Fermi 3 only.

9.4.2.1 Alternative Intake Designs and Locations

While NUREG-1555 suggests that the intake system evaluation address alternative intake systems, locations, pumping arrangements, defouling processes and screens; the Base Case detailed design has not matured sufficiently to support a comparative evaluation of alternative pumping, defouling and screen systems. Consequently, the evaluation of the intake Base Case and alternatives is limited to the intake system and intake location. Table 9.4-3 and Table 9.4-4 provide an evaluation or comparison of the following Base Case and alternative intake systems and locations:

- Alternative Intake Systems are as follows:

- Shoreline Intake System (Base Case): Partially submerged concrete inlet structure positioned inside the intake bay along the shoreline. Additional discussion of the Base Case is provided in Section 3.4.
- Offshore Intake (Alternative 1): Completely submerged intake structure(s) positioned just above the bottom of the body of water supply source, some distance from shore.

- Alternative Intake Locations are as follows:
  - Existing Intake Location (Base Case): Intake location between the two groins that extend into Lake Erie.
  - Alternate Intake Location on Lake Erie (Alternative 2): Intake location at least several hundred feet away from the existing Fermi 2 intake structure.

The evaluation in Table 9.4-3 and Table 9.4-4 concludes that:

- An Offshore Intake System or Alternate Intake Location would be difficult to permit.
- The alternatives could generate larger environmental impacts relative to the Base Case intake system arrangement.
- The alternatives could trigger costly additional permitting, stakeholder consultations, and environmental restoration. Therefore, further economic evaluation of the Base Case and alternative intake systems is unwarranted.

9.4.2.2 **Alternative Discharge Designs and Locations**

While NUREG-1555 also suggests that the discharge system evaluation address alternative discharge systems, locations, and discharge port technology, the conceptual Base Case discharge design can only support consideration of alternate discharge systems and locations. The discharge water quantity is smaller than the intake because the discharge comprises cooling tower blowdown, whereas the intake comprises make-up for evaporative losses, drift losses, and blowdown. Table 9.4-5 and Table 9.4-6 provide comparisons of the Base Case and alternative discharge systems and locations.

- Alternative Discharge Systems are as follows:
  - Offshore Discharge (Base Case): Completely submerged discharge structure(s) positioned just above the receiving water body bottom, some distance from shore.
  - Shoreline Discharge (Alternative 3): Concrete, partially submerged, discharge structure along shoreline of receiving body of water.
- Alternative Discharge Locations are as follows:
  - Offshore, Pipe Routing Adjacent to the Intake (Base Case): As discussed in Subsection 5.3.2, the blowdown pipe will extend approximately 1300 feet offshore, passing near the existing intake structure. This is further discussed in Section 3.4.
  - Inland Discharge (Alternative 4): Fermi 3 has several inland lagoons that could support discharge.

The evaluation in Table 9.4-5 and Table 9.4-6 concludes that: 1) the discharge system alternatives may be more difficult to permit than the Base Case, and 2) the discharge system alternatives could generate larger adverse environmental impacts relative to the Base Case discharge system arrangement. Further economic evaluation of the Base Case and alternative discharge systems is unwarranted.

9.4.2.3 **Alternative Water Supplies**

Groundwater in the vicinity of Fermi 3 is not sufficient to provide the required volume of cooling water. As discussed in Subsection 2.3.1.2, groundwater in the vicinity of Fermi is not used onsite. Moreover, the evaluation of alternative water supplies prescribed by NUREG-1555 is not needed because of the certainty of water supply (Lake Erie) for the Fermi 3 preferred closed-cycle wet cooling tower system. Lake Erie is the prevalent water source in the vicinity of Fermi 3, and has historically been proven to be a reliable source.

9.4.2.4 **Alternative Water Treatment**

The evaluation of the water treatment processes herein focuses on the water treatment system conceptual design for Fermi 3. Table 9.4-7 provides an evaluation of the Base Case and alternative water treatment systems.

- Alternative Water Treatment Systems are as follows:
    - Chemical Treatment (Base Case): Cooling water biocide, dehalogenation, and corrosion and scale inhibitor chemical additives, based on a maximum value of two cycles of concentration. Additional discussion of the chemical treatments proposed in the Base Case can be found in Section 3.3 and Section 3.4.
    - Non-chemical Treatment – Mechanical Treatment (Alternative 5): Periodic mechanical cleaning or coating of the cooling tower basin to avoid the accumulation of zebra mussels.
    - Non-chemical Treatment – Thermal Shock (Alternative 6): Thermal shock treatment for a brief period of time to eradicate the presence of zebra mussels.

The evaluation in Table 9.4-7 demonstrates that the Fermi 3 Base Case chemical treatment option poses adverse environmental impacts. However these impacts are SMALL and well within the current allowances outlined in the Fermi 2 NPDES permit. The mechanical cleaning system represents the environmentally-preferred treatment system for the Fermi 3 condenser for biologicals. However the mechanical cleaning process is not practical for the cooling towers. Therefore, chemical treatment (Base Case) is necessary. A chemical treatment system would be selected that meets environmental impact limits. When necessary, thermal shock treatment could be utilized in addition to chemical treatments. Section 3.3 discusses the chemical treatment processes, as well as thermal shock treatment. Further economic evaluation of the Base Case and alternative water treatment systems is unwarranted.

9.4.2.5 Summary

The evaluation of the key components (excluding water supply) of the Base Case and alternative make-up water intake systems for Fermi 3 indicates that the following Base Case configuration collectively represents the most environmentally preferable circulating water system:

- Intake System: Shoreline
- Intake Location: Between the two groins that extend into Lake Erie
- Discharge System: Offshore
- Discharge Location: Offshore, pipe routing adjacent to the intake
- Water Supply: Lake Erie
- Water Treatment: Chemical biocide/corrosion/scale treatment/dehalogentation

9.4.3 Transmission Systems

NUREG-1555, Section 9.4.3 states:

> In some cases transmission lines may be constructed and operated by an entity other than the applicant. In such cases, alternate routes and impact information may be limited and the reviewer should proceed with the assessment using the information that can be obtained.

In the case of Fermi 3, the transmission lines are constructed and operated by the ITC*Transmission*. ITC*Transmission* owns and operates the electrical switchyards at Fermi 2 and Fermi 3 and the corresponding electrical transmission system. The interconnection point is between Fermi 3 and the switchyard.

In November 1999, ITC*Transmission* was created as an independently functioning business unit within Detroit Edison. This was the first step in the formation of a truly independent, stand-alone transmission company. In May 2000, ITC*Transmission*, Detroit Edison, and DTE Energy filed a joint application with the Federal Energy Regulatory Commission (FERC), seeking permission to transfer all jurisdictional transmission assets from Detroit Edison to ITC*Transmission*. This approval was granted in June of 2000. On June 1, 2001, ITC*Transmission* began operations as a wholly owned subsidiary of DTE Energy. In December 2001, ITC*Transmission* joined the Midwest ISO, a FERC-approved regional transmission organization. ITC*Transmission* was the first company to join Midwest ISO under Appendix I of the Midwest ISO agreement, which allowed an independent transmission company certain freedoms to continue operation as a for-profit stand-alone business. On February 28, 2003, ITC*Transmission* became a stand-alone transmission company following the sale of transmission assets from DTE Energy. On April 8, 2004, ITC*Transmission* became the United States' first fully independent transmission company after completing the transition by assuming construction and maintenance activities from DTE Energy. (Reference 9.4-3) ITC*Transmission* operates within the Midwest ISO regional reliability area and is an essential link in the safe, cost-effective delivery of electric power across much of North America.

As discussed in Subsection 8.1.3 and Subsection 8.3.1.2, one of Midwest ISO's primary roles is the oversight of the reliability planning process. Midwest ISO manages incremental generation capacity development through the Generation Interconnection Request Queue. Developers wishing to provide new incremental generation must file an interconnection request and enter into Midwest ISO's queue-based, three-study interconnection process, which provides developers the flexibility to consider and explore their respective generation interconnection business opportunities. While a developer can withdraw a project from the Generation Interconnection Queue at any point, the process is structured such that each step imposes its own increasing financial obligations on the developer. It is recognized that not all projects in the Generation Interconnection Queue are likely to be built, but the Queue provides an authoritative source for future generation investment trends in the Midwest ISO Regional Transmission Organization.

As part of the Midwest ISO interconnection process, various studies and analyses are performed including feasibility and system impact studies. For the ITC*Transmission* service area, the Midwest ISO typically has ITC*Transmission* perform the studies and analyses. As part of these work activities, the Midwest ISO and ITC*Transmission* determine necessary upgrades to the transmission system. This process has been followed for the proposed connection of Fermi 3 to the ITC*Transmission* system. The transmission system configuration and routing are discussed in Section 2.2 and Section 3.7.

ITC*Transmission* follows the applicable regulatory processes and approvals in order to implement changes to the transmission system. As discussed above, the interconnection studies are performed by ITC*Transmission*, including determining the routing for these new transmission lines. As part of this process, Detroit Edison is not involved in the evaluation or decision making for proposed changes to the transmission system or possible design alternatives. Accordingly, Detroit Edison cannot reasonably provide the transmission system design alternatives considered by ITC*Transmission*.

9.4.4 **References**

9.4-1 U.S. Environmental Protection Agency, CWA 316(b), "Technical Development Document for the Final Regulations," EPA-821-R-01-036, Chapter 3: Energy Penalties, Air Emissions, and Cooling Tower Side Effects, November 2001.

9.4-2 Edison Electric Institute, "Electric Power Plant Environmental Noise Guide," Volume I, 1978.

9.4-3 ITC*Transmission* History and General Information, http://www.itctransco.com/app.php?sec=&id=3, accessed 18 January 2008.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 1 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Land Use: Onsite Land Considerations	Land use considerations are based on Subsection 2.2.1. A natural draft cooling tower (NDCT) system would require less land (as compared to most alternatives, save a once-through). A NDCT system could be placed within the confines of the existing Fermi 2 site.	The once-through (OT) system would have the smallest land requirements. The OT system could be placed within the confines of the existing Fermi 2 site.	A once-through and helper tower (OTHT) system would require marginally more land than is required by the OT system alone, but less than other cooling tower systems. The OTHT system could be placed within the confines of the existing Fermi 2 site.	A combination dry and wet mechanical draft cooling tower (CDWMDCT) system would require more land (as compared to the NDCT system) to site widely spaced dry and wet towers. A CDWMDCT system could be placed within the confines of the existing Fermi 2 site.	A MDCT system would require more land (as compared to the NDCT system) to site the towers. A MDCT system could be placed within the confines of the existing Fermi 2 site. Current land use at Fermi 2 is discussed in Subsection 2.2.1.	A spray pond-cooling alternative would involve the development of significant additional surface water impoundments and consequently pose the additional land requirements. It is unlikely that new spray ponds of sufficient size could be placed within the confines of the existing Fermi 2 site, based on Subsection 2.2.1 discussion of land use.	A dry tower system would require more land than wet cooling tower systems. The dry tower system would require up to 10 times the land use area of the NDCT system (Base Case). Dry towers may not be able to be situated within the confines of the existing Fermi 2 site. Based on Subsection 2.2.1, a relatively high percentage of Fermi site is wetlands.
Land Use: Terrain Considerations	NDCT systems withdraw less water and so are less affected by substantial terrain variations. Terrain features of the site are suitable for an NDCT system.	OT systems require flat or gently rolling terrain to minimize pump head requirements. Terrain features of the site would not preclude the use of the OT system.	OTHT systems require flat or gently rolling terrain situations. Terrain features of the site are suitable for an OTHT system.	CDWMDCT system withdraws less water and so is less affected by significant terrain variations. Terrain features of the site are suitable for a CDWMDCT system.	MDCT systems withdraw less water and so are less affected by significant terrain variations. Terrain features of the site are suitable for a MDCT system.	Since spray pond construction involves substantial earthwork, such systems are most appropriate for flat or gently rolling terrain. Terrain features of the site are not suitable for the addition of spray ponds, due to the fact that a relatively high percentage of the Fermi site is wetlands according to Subsection 2.2.1.	Dry tower systems are unaffected by terrain considerations.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 2 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Water Use	The water intake requirements for the NDCT system are approximately equal to those of the MDCT and the CDWMDCT. Area hydrology is discussed in Subsection 2.3.1.	An OT system would have an intake requirement of nearly 20 times more water than a NDCT system. OT - 720,000 gpm, wet cooling systems – 34,000 gpm. Despite this increased water intake requirement, the OT system would return most of the withdrawn water.	An OTHT system would require the second largest water supply. Although the helper tower system would reduce water intake requirements, its use would not reduce water usage to below the natural draft cooling tower operation.	The closed wet cooling tower system would have considerable evaporative losses to the atmosphere, but these losses could be reduced by operation of the dry towers in the maximum water conservation mode, thus reducing the water usage and conserving water during drought conditions.	The water intake requirements for the MDCT system and the NDCT system are approximately the same.	A spray pond would require large volumes of water. Area hydrology is discussed in Subsection 2.3.1.	A dry tower system would have no comparable evaporative water losses when compared with NDCTs. A dry tower system would require minimal makeup water.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 3 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Regulatory Restrictions	An intake structure for an NDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The NPDES discharge permit thermal discharge limitation to the lake would need to be modified to account for the small additional thermal load from NDCT blowdown. Current water use and water quality are discussed in Subsection 2.3.2 and Subsection 2.3.3.	The intake structure for the OT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. Because of concerns with thermal impacts and water consumption, permitting would be difficult. Current water use and water quality are discussed in Subsection 2.3.2 and Subsection 2.3.3.	An intake structure for the OTHT systems would meet Section 316(b) of the CWA and the implementing regulations, as applicable. While the helper tower would temper the thermal loading to the lake during the hottest summer season periods, concerns with thermal impacts and water consumption would pose an impediment to permitting. Current water use and quality are discussed in Subsection 2.3.2 and Subsection 2.3.3.	An intake structure for a CDWMDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The NPDES discharge permit thermal discharge limitation to the lake would need to be modified to account for the minor additional thermal load rejected by the new CDWMDCT system. These regulatory restrictions would have small impacts on this heat dissipation system. Current site water use and quality are discussed in Subsection 2.3.2 and Subsection 2.3.3.	An intake structure for an MDCT system would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The NPDES discharge permit thermal discharge limitation to the lake would need to be modified to account for the minor additional thermal load from the MDCT blowdown. Current site water use and quality are discussed in Subsection 2.3.2 and Subsection 2.3.3.	Additional land would have to be obtained and developed to support the spray pond option. The development of this land may entail a substantial and lengthy Federal, State, and local permit and approval process.	There would be little or no permit or approval-related impacts to the dry tower system alternative.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 4 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Atmospheric Effects	An NDCT system would emit water droplets (drift) and intermittently produce a visible plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would not encourage any additional fogging or icing conditions on local road systems. Visible plume aesthetic impacts would be small. Current site meteorology is discussed in Section 2.7.	Since OT systems do not produce a visible plume and the associated pond-induced fogging (steam fog) is minimal, atmospheric effects would be small.	An OTHT system would emit water droplets (drift) and produce visible plumes during periods when the helper tower is in operation. The particulate, salt deposition and fogging and aesthetic impacts would not be significant from the infrequent/intermittent operation of this small cooling tower.	The CDWMDCT system would emit water droplets (drift) and intermittently produce a visible vapor plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would result in minimal additional fogging but no icing conditions on local road systems. Aesthetic impacts from the visible plume would be small.	The MDCT system would emit water droplets (drift) and intermittently produce a visible vapor plume. The drift droplets would be a minor source of particulate matter and salt deposition. The water vapor plume would result in minimal additional fogging but no icing conditions on local road systems. Aesthetic impacts from the visible plume would be small.	A spray pond system could produce a low-level visible water droplet plume and encourage formation of fog above the heated pond. These impacts would be localized and short-lived, and consequently small. Current site and area meteorology is discussed in Section 2.7.	A dry tower system would not produce a visible plume or pose particulate emission or salt deposition impacts.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 5 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Thermal and Physical Effects	An NDCT system would produce a small thermal load to the lake because a significant portion of the heat removal in these towers is associated with evaporation and most of the remaining heat is dissipated directly to the atmosphere. The small NDCT thermal load rejected to the lake would be additive to the NDCTs' thermal load from the existing unit. The NPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.	The OT system would add thermal load to the lake. The NPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.	An OTHT system would add thermal load to the lake. The helper tower would temper the thermal loading to the lake during the hottest summer season periods, but the thermal impact would be greater than the Base Case. The NPDES permit thermal discharge criteria would need to be revised to reflect this addition of thermal load.	The CDWMDCT system would discharge a significantly smaller thermal load to the lake (compared to OT systems) because a significant portion of the heat removal in cooling towers is associated with evaporation. Most of the remaining heat is dissipated directly to the atmosphere. The small amount of heat from blowdown to Lake Erie would be additive to the NDCTs' thermal load from the existing unit. The NPDES permit thermal discharge criteria would need to be revised to reflect this minor addition.	The MDCT system would discharge a small thermal load to the lake because a significant portion of the heat removal in cooling towers is associated with evaporation. Most of the remaining heat is dissipated directly to the atmosphere. The small MDCT thermal load rejected to the lake would be additive to the NDCTs' thermal load from the existing unit. The NPDES permit thermal discharge criteria would need to be revised to reflect this small thermal load addition.	Since the thermal load would be rejected to the spray pond and that pond would be wholly dedicated to industrial use, the thermal impacts external to the pond would be small to none.	A dry tower system would direct an invisible heated plume of air into the atmosphere, and impacts would be small.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 6 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Noise Levels	An NDCT system would produce less noise than a mechanical draft tower system because of the absence of fan-generated noise. The results of the Section 5.3.4 noise evaluation for a NDCT suggest that noise impacts would be below the NRC-defined significance levels (65 dBA) at the EAB. (Reference 9.4-2) Construction related noise impacts would be small.	OT system operation would generate small noise impacts from pump operation. Construction-related noise impacts would be small.	OTHT operation would generate noise from fan and pump operation and from cascading water in the towers during the periods when the helper tower is needed. The associated noise impacts would be less than the NDCT impacts, which were below the NRC-defined significance levels (65 dBA) at the EAB as described in Section 5.3.4. Construction-related noise impacts would be small.	CDWMDCT operation would generate noise from fan and pump operation and from cascading water in the towers. The noise impacts for the CDWMDCT would be below the NRC-defined significance levels (65 dBA) at the EAB. Construction related noise impacts would be small.	MDCT operation would generate noise from fan and pump operation and from cascading water in the towers. The results of the Section 5.3.4 noise evaluation suggests that noise impacts for the MDCT would also be below the NRC-defined significance levels (65 dBA) at the EAB. Construction-related noise impacts would be small.	Spray pond system operation would generate noise from the spray operations. Since the location of the spray ponds and associated receptor boundaries are presently undefined, the associated noise impacts cannot be evaluated at this time. Construction-related noise impacts would be small.	A dry tower system would generate operational noise from fan operation. The Section 5.3.4 noise evaluation for a dry tower system indicates that noise contributions from a dry tower system would produce impacts below the NRC-defined significance levels (65 dBA) at the EAB. Construction-related noise impacts would be small.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 7 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Aesthetics and Recreational Benefits	An NDCT system would be wholly situated on the existing Fermi 2 site and its primary external impact would be the discharge of heated water to Lake Erie. Discharges to Lake Erie would produce no tangible aesthetic or recreational benefits. The NDCT is a rather large, imposing structure, not very aesthetically pleasing – however the Fermi site already has two other NDCTs, addition of a third would have little affect.	The OT system would be wholly situated on the existing Fermi 2 site and its primary external impact would be the discharge of a large quantity of heated water to Lake Erie. Discharges to the lake would produce no tangible aesthetic or recreational benefits. An OT would have little to no aesthetic affect, because there is no tower.	An OTHT system would be wholly situated on the existing Fermi 2 site and its primary external impact would be the discharge of large quantity of heated water to the Lake Erie. Discharges to Lake Erie, would produce no tangible aesthetic or recreational benefits. An OTHT would have little to no aesthetic affect.	The CDWMDCT system would be wholly situated on the existing Fermi 2 site and the primary external impact would be the minor discharge of heated water to Lake Erie. Discharges to the lake would produce no tangible aesthetic or recreational benefits. A CDWMDCT would have a lesser aesthetic affect than that of a NDCT.	The MDCT system would be wholly situated on the existing Fermi 2 site and the primary external impact would be the discharge of heated water to Lake Erie. Discharges to the lake would produce no tangible aesthetic or recreational benefits. A MDCT would have a lesser aesthetic affect than that of a NDCT.	The spray ponds would be at least partially situated on land outside of the Fermi 2 site. The resulting commitment of previously undeveloped property to industrial use would produce no tangible aesthetic or recreational benefits. Spray ponds would have a lesser aesthetic affect than that of a NDCT.	A dry tower system would be wholly situated on the existing Fermi 2 site and their primary external impact would be the discharge of heated air and noise to the atmosphere. These discharges would produce no tangible aesthetic or recreational benefits. A dry tower system would have a lesser aesthetic affect than that of a NDCT.
Operating and Maintenance Experience	NDCT systems are common to older power plants (both fossil and nuclear) and they are considered highly reliable.	OT systems are common to older power plants (both fossil and nuclear) and they are considered highly reliable.	While OTHT systems are less common than OT systems, they do not pose any greater operating and maintenance risks than other cooling tower systems.	Dry and wet tower systems are common to power plants (both fossil and nuclear) and are considered highly reliable.	MDCT systems are common to power plants (both fossil and nuclear) and are considered highly reliable.	Spray pond systems have been used on power plant sites and they pose no operational and maintenance constraints.	Dry tower systems are becoming more popular at power plants. Their more limited operating experience indicates that their reliability is similar to wet cooling towers. While dry tower systems are less common, they do not pose any greater operating and maintenance risks than other cooling systems.

Table 9.4-1 Screening of Alternative Heat Dissipation Systems (Sheet 8 of 8)

Factors Affecting System Selection	Natural Draft Cooling Tower (Base Case)	Once-Through (Alternative 1)	Once-Through with Helper Tower (Alternative 2)	Combination Dry and Wet Towers (Alternative 3)	Mechanical Draft Cooling Towers (Alternative 4)	Spray Ponds (Alternative 5)	Dry Towers (Alternative 6)
Generating Efficiency Penalty	Natural draft cooling tower energy requirements would be less than the CDWMDCT and the mechanical draft systems. (Reference 9.4-1, Tables 3-1 and 3-2)	The OT system has the least energy requirement. The energy penalty (% reduction in plant output) of wet tower systems versus OT systems is 1.7 to 1.9%. The energy penalty of dry tower systems versus OT systems is 8.5 to 11.4%. (Reference 9.4-1, Tables 3-1 and 3-2)	The additional energy requirements associated with cooling tower operation do not alter this system's energy efficiency advantages over wet cooling tower only systems.	The energy requirements for CDWMDCTs would be more than the NDCT system.	The energy requirements for MDCTs would be more than the NDCT system.	Spray ponds' efficiency penalty is greater than OT systems, but smaller than all the other cooling tower system based alternatives.	The energy requirements for a dry tower would be more than the NDCT system. The dry tower system can not produce the needed performance required during periods of high ambient dry bulb temperature (>95°F) without periods of significant power output reduction.
Is this a suitable heat dissipation system?	Yes	No	No	Yes	Yes	No	Yes

Table 9.4-2 Summary Comparison of Heat Dissipation Systems Impacts

Criteria	Base Case NDCT	Alternative 1 OT	Alternative 2 OTHT	Alternative 3 CDWMDCT	Alternative 4 MDCT	Alternative 5 SP	Alternative 6 Dry Tower
Land Use	Low	Low	Low	Medium	Medium	High	High
Water Use	Medium	High	High	Medium	Medium	High	Low
Regulatory Barriers	Low	High	High	Low	Low	High	Low
Air Impacts	Medium	Low	Low	Medium	Medium	Low	Low
Thermal/Physical Impacts	Medium	High	High	Low	Medium	Medium	Low
Noise Impacts	Medium	Low	Low	Medium	Medium	Low	Medium
Aesthetics & Recreational Benefits	None	None	None	None	None	None	None
Operating and Maintenance Experience	High	High	Medium	High	High	Medium	Low
Generating Efficiency Penalty	Low	Low	Low	Medium	Medium	Low	High
Overall Environmental & Operability Ranking	Preferable	Unacceptable	Unacceptable	Acceptable	Acceptable	Unacceptable	Acceptable
Capital Costs	Medium	Not evaluated	Not evaluated	Medium	Medium	Not evaluated	High
Operating Costs	Low	Not evaluated	Not evaluated	Medium	Medium	Not evaluated	High
Costs Ranking	Acceptable	Not evaluated	Not evaluated	Acceptable	Acceptable	Not evaluated	Unacceptable
Overall Preference	X						

Table 9.4-3 Screening of Alternatives to the Proposed Intake System (Base Case & Alternative 1)

	Intake System – Base Case	Intake System - Alternative 1
Factors Affecting System Selection	**Shoreline Intake on Lake Erie**	**Offshore Intake System**
Construction Impacts	Since development of the intake shoreline would result in disruptions of the littoral zone (i.e., area of more concentrated biological resources), there could be localized adverse impacts to this disturbed zone. Since previous development in this zone and the new intake would be adjacent to an operational water intake system, these impacts would be minor. Experience has shown that impacts near shorelines (i.e., transportation of silt) are more readily controllable near the shoreline than offshore.	If the offsite intake system is installed using an open trench construction process, there could be large adverse impacts to both the littoral zone and to deeper areas of Lake Erie. This process would result in greater lakebed disruptions and larger increases in the turbidity of Lake Erie water. The resulting adverse impact to Lake Erie water quality could be large during the construction phase of work.
Aquatic Impacts	The potentially significant adverse operational impacts to aquatic life would be reduced by reducing intake velocities and using traveling screens to reduce impingement, entrapment and entrainment of aquatic life. Thus operational impacts would be minor.	Situated in areas with relatively less abundant aquatic resources, submerged offsite intake systems generally pose fewer impacts to aquatic life during operation.
Land Use Impacts	Since the commitment of land for the shoreline intake is small and this development would occur on the Fermi site, land use impacts would not be an important differentiating factor for intake systems.	The commitment of land on the shoreline for an offshore intake is small and this development would occur on the Fermi site, land use impacts would not be an important differentiating factor.
Water Use Impacts	The relative position of the intake (shoreline or offshore) would have no differentiating impact on the water use requirements and therefore, it would not be an important factor.	The relative position of the intake (shoreline or offshore) would have no differentiating impact on the water use requirements, and therefore, it would not be an important factor.
Compliance with Regulations	The intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The applicable NPDES permit and current Section 316(b) considerations (aquatic species entrainment-impingement-entrapment) issues would need to be modified in response to the additional intake. These regulatory restrictions would not be an important differentiating factor.	The intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The applicable NPDES permit and current Section 316(b) considerations (aquatic species entrainment-impingement-entrapment) issues would need to be modified in response to the additional intake. These regulatory restrictions would not be an important differentiating factor.
Environmentally preferred or equivalent?	Yes	No

Table 9.4-4 Screening of Alternatives to the Proposed Intake Location (Base Case & Alternative 2) (Sheet 1 of 2)

Factors Affecting Location Selection	Intake Location - Base Case Between the two groins that extend into Lake Erie	Intake Location - Alternative 2 Alternative Location on Lake Erie
Construction Impacts	Construction impacts would be minimized if the intake structure is located adjacent to the existing Fermi site intake. Already cleared and graded in support of the original intake system development, this area has fewer ecological resources than other shoreline locations. Proximity to shore would allow use of best management practices to control the movement of silt and minimize impact on Lake Erie.	Construction impacts from the disruption of shoreline environment would be larger for alternative shoreline locations along Lake Erie, since these areas have not been impacted by previous construction activities.
Aquatic Impacts	The potentially large adverse operational impacts to aquatic ecosystems could be mitigated and rendered small by applying management techniques in use at the existing intake (e.g., minimized intake velocity, screens).	The potentially large adverse operational impacts to aquatic ecosystems could be mitigated and rendered small by applying management techniques in use at the existing intake (e.g., minimized intake velocity, screens). A new location would also necessitate the use of practices in use in the vicinity of the current Fermi 2 intake, such as dredging, in a new location, causing additional impacts where none previously were experienced.
Land Use Impacts	Since the new intake would reside totally within the confines of the site, its location adjacent to another intake, poses the smallest land use impacts.	Land use designations outside of the site do not support the installation or operation of industrial facilities. Thus, development of intake locations in these areas would trigger potentially onerous land use amendment processes, which would make this alternative less desirable than the Base Case.
Water Use Impacts	Since Lake Erie represents the largest source of water for industrial use in the area, the related water use impacts of an adjacent intake system would be small relative to other potential locations.	Since Lake Erie represents the largest source of water for industrial use in the area, the related water use impacts of a new adjacent intake system would be small relative to potential impacts from other locations.
Compliance with Regulations	The intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The applicable NPDES permit and current Section 316(b) issues (aquatic species entrainment-impingement-entrapment) would need to be modified in response to the additional intake. Thus, these regulatory restrictions would not be an important differentiating factor.	The intake structure would meet Section 316(b) of the CWA and the implementing regulations, as applicable. The applicable NPDES permit and current Section 316(b) issues (aquatic species entrainment-impingement-entrapment) would need to be modified in response to the additional intake. Thus, these regulatory restrictions would not be an important differentiating factor.

Table 9.4-4 Screening of Alternatives to the Proposed Intake Location (Base Case & Alternative 2) (Sheet 2 of 2)

	Intake Location - Base Case	**Intake Location - Alternative 2**
Factors Affecting Location Selection	**Between the two groins that extend into Lake Erie**	**Alternative Location on Lake Erie**
Environmentally preferred or equivalent?	Yes	No

Table 9.4-5 Screening of Alternatives to the Proposed Discharge System (Base Case & Alternative 3)

	Discharge System – Base Case	Discharge System - Alternative 3
Factors Affecting System Selection	**Offshore Submerged Discharge System**	**Shoreline Discharge & Discharge Canal**
Construction Impacts	The offshore discharge system will be located on the surface of the lakebed. Lake bottom construction activities would result in greater lakebed disruptions and larger increases in the turbidity of Lake Erie water. The resulting adverse impact on Lake Erie water quality could be SMALL during the construction phase of work. It should be noted that the Fermi 1 intake pipe is routed in the same location as the Fermi 3 discharge pipe.	Since development of the shoreline discharge would result in disruptions of the littoral zone (area of more concentrated biological resources), there would be localized MODERATE adverse impacts on this disturbed zone.
Aquatic Impacts	Situated in areas with relatively less abundant aquatic resources (outside of more ecologically abundant littoral zone), submerged offsite intake systems generally pose fewer impacts on the aquatic ecosystem.	Situated in the more biologically important littoral zone areas, shoreline discharges would have the potential to disturb the local aquatic ecosystem and the wetlands. Such systems pose greater impacts than offshore discharge systems.
Land Use Impacts	Though offshore discharge systems have somewhat lesser land requirements than shoreline intake systems, land use impacts would not be an important differentiating factor. Note that areas with submerged systems would be clearly indicated with appropriate markings on the lake surface, to preclude any interference with recreational water uses.	Since the commitment of land for the shoreline discharge is not significant, land use impacts would not be an important differentiating factor.
Water Use Impacts	An offshore discharge would be preferable to a shoreline discharge. An offshore discharge largely reduces possible interference with the intake. Note that areas with submerged systems would be clearly indicated with appropriate markings on the lake surface, to preclude any interference with recreational water uses.	The relative position of the shoreline discharge would have possible impacts on the intake depending on lake currents, which are variable throughout the year. A shoreline discharge could affect the water quality in the vicinity of the intake.
Compliance with Regulations	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable NPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge. These regulatory restrictions would not be an important differentiating factor.	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable NPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge. These regulatory restrictions would not be an important differentiating factor.
Environmentally preferred or equivalent?	Yes	No

Table 9.4-6 Screening of Alternatives to the Proposed Discharge Location (Base Case & Alternative 4) (Sheet 1 of 2)

	Discharge Location – Base Case	Discharge Location - Alternative 4
Factors Affecting Location Selection	**Offshore, Adjacent to the Intake**	**Inland Discharge**
Construction Impacts	The offshore discharge system will be located on the surface of the lakebed. Lake bottom construction activities would result in greater lakebed disruptions and larger increases in the turbidity of Lake Erie water. The resulting adverse impact on Lake Erie water quality could be SMALL during the construction phase of work. It should be noted that the Fermi 1 intake pipe is routed in the same location as the Fermi 3 discharge pipe, therefore additional disruption is minimal because this area has been previously disturbed. Additionally, an offshore discharge would provide protection, both chemically and thermally, to the South Lagoon in the even of a seiche event.	Since development of the inland discharge would result in disruptions of the inland lagoons, specifically the South Lagoon under the conditions of a seiche event. There could be localized MODERATE adverse impacts on this disturbed zone.
Aquatic Impacts	Situated in areas with relatively less abundant aquatic resources (outside of more ecologically abundant littoral zone), submerged offsite intake systems generally pose fewer impacts on the aquatic ecosystem.	Inland discharges would have the potential to disturb the local aquatic ecosystem. Such systems pose greater impacts than offshore discharge systems.
Land Use Impacts	Though offshore discharge systems have somewhat lesser land requirements than shoreline intake systems, land use impacts would not be an important differentiating factor. Note that areas with submerged systems would be clearly indicated with appropriate markings on the lake surface, to preclude any interference with recreational water uses.	Since the commitment of land for the inland discharge is not significant, land use impacts would not be an important differentiating factor.
Water Use Impacts	An offshore discharge would be preferable to a shoreline discharge. An offshore discharge largely reduces possible interference with the intake. Note that areas with submerged systems would be clearly indicated with appropriate markings on the lake surface, to preclude any interference with recreational water uses.	The relative position of the inland discharge would have little impact on the water use requirements and, therefore, it would not be an important differentiating factor.

Table 9.4-6 Screening of Alternatives to the Proposed Discharge Location (Base Case & Alternative 4) (Sheet 2 of 2)

Factors Affecting Location Selection	Discharge Location – Base Case Offshore, Adjacent to the Intake	Discharge Location - Alternative 4 Inland Discharge
Compliance with Regulations	The discharge system would meet the requirements of Section 316(a) of the CWA, and the implementing regulations, as applicable. The applicable NPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge. These regulatory restrictions would not be an important differentiating factor.	The discharge system would not meet the requirements of all local regulations, as applicable. There are strict thermal discharge limitations for the inland lagoons. The thermal limitations could pose permitting difficulties. The applicable NPDES permit and Section 316(a) thermal impact considerations would need to be evaluated in response to the additional discharge.
Environmentally preferred or equivalent?	Yes	No

Table 9.4-7 Screening of Alternatives to the Proposed Water Treatment System (Base Case & Alternatives 5 & 6)

	Water Treatment Base Case	Water Treatment System Alternative 5	Water Treatment System Alternative 6
Factors Affecting System Selection	**Chemical Treatment: Biocide, Corrosion Inhibitor, etc.**	**Non-chemical Treatment: Mechanical Treatment**	**Non-chemical Treatment: Thermal Shock**
Chemicals Used	Biocide – sodium hypochlorite. Corrosion inhibitors – Phosphoric Acid (30%). Scale inhibitor – $C_2H_3OH(PO(OH)_2)_2$. Dehalogenation – sodium bisulfite.	None.	None.
Aquatic Impacts	Residual chemicals from this treatment process could impact aquatic resources in Lake Erie. Biocides, corrosion inhibitors, and scale inhibitors are potentially toxic to aquatic life.	While mechanical cleaning measures would remove biological materials from surfaces, these measures would not pose systemic impacts on aquatic resources in Lake Erie.	The increase in temperature would be lethal to biological materials within the system, specifically zebra mussels. Effluent of a certain temperature could prove disruptive to aquatic life in Lake Erie.
Land Use Impacts	The chemical treatment systems do require additional land; however these systems would be wholly-confined to the existing site. There would be no appreciable land use impacts.	Mechanical cleaning measures would require minimal additional commitment of land. There would be no appreciable land use impacts.	Thermal shock treatment would require minimal additional commitment of land. There would be no appreciable land use impacts.
Water Use Impacts	Chemical treatment systems would not impact water withdrawal requirements.	Mechanical cleaning would not impact water withdrawal requirements.	Thermal shock treatment would not impact water withdrawal requirements.
Water Use Impacts	Chemical treatment systems would not impact water withdrawal requirements.	Mechanical cleaning would not impact water withdrawal requirements.	Thermal shock treatment would not impact water withdrawal requirements.
Compliance with Regulations	The addition of chemical treatment systems would impact the current NPDES discharge permit. The Fermi 2 permit would need to be revised or a new permit issued for Fermi 3, in response to the revised characterization of the chemically-treated cooling system effluent.	Mechanical cleaning would be a supplemental activity, in addition to chemical treatment. It would be fully compliant with the applicable regulations and existing and pending permit conditions.	Thermal shock treatment would be a supplemental activity, in addition to chemical treatment. Elevated temperatures are necessary to eradicate zebra mussels, discharge of higher temperature water would require an adjustment to the NPDES permit.
Environmentally preferred or equivalent?	Yes	Yes	No