6. NON-SITE SPECIFIC ENVIRONMENTAL INFORMATION

6.1 REGIONAL SOCIAL AND ECONOMIC IMPACTS

This Section summarizes the likely social and economic impacts of the proposed facility on the Arrowhead Region as a whole. These regional impacts are largely independent of which site within the Taconite Tax Relief Area is selected. Site-specific social and economic impacts are provided in Section 7 (West Range Site) and in Section 8 (East Range Site.) The regional economic benefits estimated below are for Mesaba Phase I. However, the economic multipliers developed for the Mesaba Phase I are also applicable to Mesaba Phase II. Any potentially significant differences between the Phase I and Phase II Projects are noted where applicable. This section is divided into the following subsections:

- Study Area Population and Demographics
- Temporary and Permanent Employment
- Availability of Labor
- Economic Benefits
- Housing Availability and Real Estate Values

6.1.1 Study Area

The Mesaba Project represents the largest single new investment in northern Minnesota. The area selected for the regional study is the Minnesota Department of Employment and Economic Development's (DEED) Arrowhead Economic Development Region. This area consists of the following Minnesota counties:

- Aitkin
- Carlton
- Cook
- Itasca
- Koochiching
- Lake
- St. Louis

6.1.2 Arrowhead Region Population Trends

After gaining population in the 1970's, the Arrowhead Region experienced a decade-long population decline beginning in about 1980, in part due to a downturn in both the national steel industry as well as the local taconite industry. Table 6.1-1 below shows that the regional population declined about 8.5% between 1980 and 1990. St. Louis and Lake Counties, in the heart of the Iron Range, suffered the largest drop. Beginning in 1991, the population began to gradually increase. By 2000, the population recovered to slightly less than what it was in 1970. In comparison, over the same thirty years, the population of the State of Minnesota increased by 29%, from about 3.8 million people to 4.9 million.

Table 6.1-1.
Arrowhead Region Population Trends 1970-2000

Year	Population
1970	329,603
1980	343,344
1990	311,342
2000	322,073

Table 6.1-2 below, delineates regional population trends by county. On a percentage basis, Cook County is the fastest growing county in the region. Itasca County (West Range Site) has about the same population now that it did in 1980, and the population of St. Louis County (East Range Site) has dropped since 1980.

Table 6.1-2
Population Change Between Censuses by County for Arrowhead Region

				% Change	% Change
County	**1980**	**1990**	**2000**	**1980-2000**	**1990-2000**
Aitkin	13,404	12,425	15,301	14.2	23.1
Carlton	29,936	29,259	31,671	5.8	8.2
Cook	4,092	3,868	5,168	26.3	33.6
Itasca	43,069	40,863	43,992	2.1	7.7
Koochiching	17,571	16,299	14,355	-18.3	-11.9
Lake	13,043	10,415	11,058	-15.2	6.2
St. Louis	222,229	198,213	200,528	-9.8	1.2
Region	343,344	311,342	322,073	-6.2	3.4

The Minnesota State Demography Office predicts that the Arrowhead Region will continue to gain in population over the next fifteen years, increasing by about 18% by 2030. The Demography Office expects the population of St. Louis County to increase by 9% and Itasca County by 21% by 2030. During the summer the regional population increases due to the large number of temporary residents and tourists that move into the area. These seasonal increases are not reflected in census data, but should be taken into account when evaluating housing availability and transportation impacts of any new project.

6.1.3 Regional Demographics and Environmental Justice

To determine whether the Project could disproportionately impact minority or low-income residents, demographic data for the region was evaluated. Table 6.1-3 provides demographic data by race from the 2000 Census for the entire seven-county Arrowhead Region.

Table 6.1-3
2000 Census: Region 3 Arrowhead Population Profiles:
Total and Minority Populations

Regional Population (2000) by Race	Number	Percentage
White	304909	94.7
Black or African American	2171	0.7
American Indian	8342	2.6
Asian	1657	0.5
Pacific Islander (Hawaiian)	82	0
Other	653	0.2
Two or more races	4259	1.3
Total	322073	100

Table 6.1-3 indicates that at almost 95% white (including white Hispanic/Latino), the population in the region is relatively homogenous, with few concentrations of minority or low-income areas. The largest minority concentrations in the region are in central Duluth and on tribal reservations relatively distant from either the West Range or East Range Sites. The largest minority population in the Arrowhead Region is American Indian (2.6%).

6.1.4 Temporary and Permanent Workers

The University of Minnesota Duluth's Bureau of Business and Economics Research (BBER) estimated the regional and state economic and employment impacts of the Mesaba Phase I Project (BBER, 2005). The temporary and permanent employment data that were used in the BBER study are summarized in Table 6.1-4, below.

Table 6.1-4
Estimated Employment

	Temporary Construction Jobs	Permanent Operating Jobs
2007	1,286	
2008	2,708	
2009	2,728	
2010	2,985	11
2011	574	96
Typical Year		107

Total direct construction jobs are expected to peak in the year 2010 at 2,985 jobs. The majority of these jobs are skilled trades. Note that these data for construction jobs do not distinguish between full and part-time jobs, so all job numbers are reported as total jobs—not full-time equivalents.

6.1.5 Availability of Labor

Labor will be drawn from throughout the Arrowhead Region and beyond. DEED workforce data for the Arrowhead Region indicates that in 2005 the regional labor force was 167,000, with 158,000 currently employed. DEED estimates that there is, in general, an ample supply of labor in the area, but the aging population threatens to create a labor shortage in some industries by 2015 (DEED, 2005). The extent to which temporary and permanent jobs are filled by local residents is in part driven by the local labor market characteristics, the availability of unemployed or underemployed skilled construction workers, and prevailing wages. As described in Section 2.14.5, unemployment has historically been one or two percentage points higher in most of the Arrowhead Region than in the State of Minnesota as a whole. Although regional unemployment rates have declined recently, the historically persistent higher unemployment rates suggest that the region will have a skilled labor force available unless international demand for taconite, non-ferrous mining or forest products continues to increase. Some researchers believe the unemployment rates in the Arrowhead Region will return to their historically higher levels before Project construction is scheduled to begin, and the gap between the unemployment rates in the region and the rest of the state may even widen as employment in manufacturing and iron mining industries in the Northeast region again declines (BBER, 2005).

Given the labor market characteristics in northeast Minnesota, the Mesaba Project likely would not need to compete with other local businesses to attract skilled labor for permanent jobs, and thus would be able to hire operational and maintenance staff at prevailing wages. Under these circumstances, the Mesaba Project will have a positive impact on reducing the unemployment rate.

6.1.6 Housing Availability and Real Estate Value

According to 2000 census data, there are a total of about 35,300 vacant housing units in the Arrowhead Region. However, of these, 27,600 (78%) are for seasonal, recreational, or occasional use. That leaves approximately 7,700 year-round housing units potentially available for temporary or permanent housing during the construction period and after. While a detailed assessment of the location of these units relative to the two sites under consideration has not been undertaken, given the new housing development in the Hoyt Lakes area (Minnesota Power lease property, for example), and the proximity of other significant population centers to both sites, adequate housing should be available for the temporary influx of workers. Long-term, housing for the 185 new employees and their families, as well as for other indirect or induced employees in the area, would be available within commuting distance of either site.

Regarding real estate impacts, the median housing value of homes in Taconite, near the West Range Site, and in Hoyt Lakes, near the East Range Site, is about $40,000 (2000 Census).

Lakefront property in the area, however, has a considerably higher property value due to the demand for seasonal and recreational housing in the area. A few homes located near the West Range Site may be reduced in value because of the proximity of the rail operations and view of the new plant itself. However, the influx of construction and operation jobs, and the associated economic benefits of the Project will, in general, create housing demand in the area and increase income. This increased housing demand and income in turn will lead to increased real estate values in the area. There are few, if any, homes located near enough the East Range Site to be negatively affected by the project. As in Taconite, in Hoyt Lakes the influx of temporary and permanent workers for the facility would increase housing demand and increase property values.

6.1.7 Employment

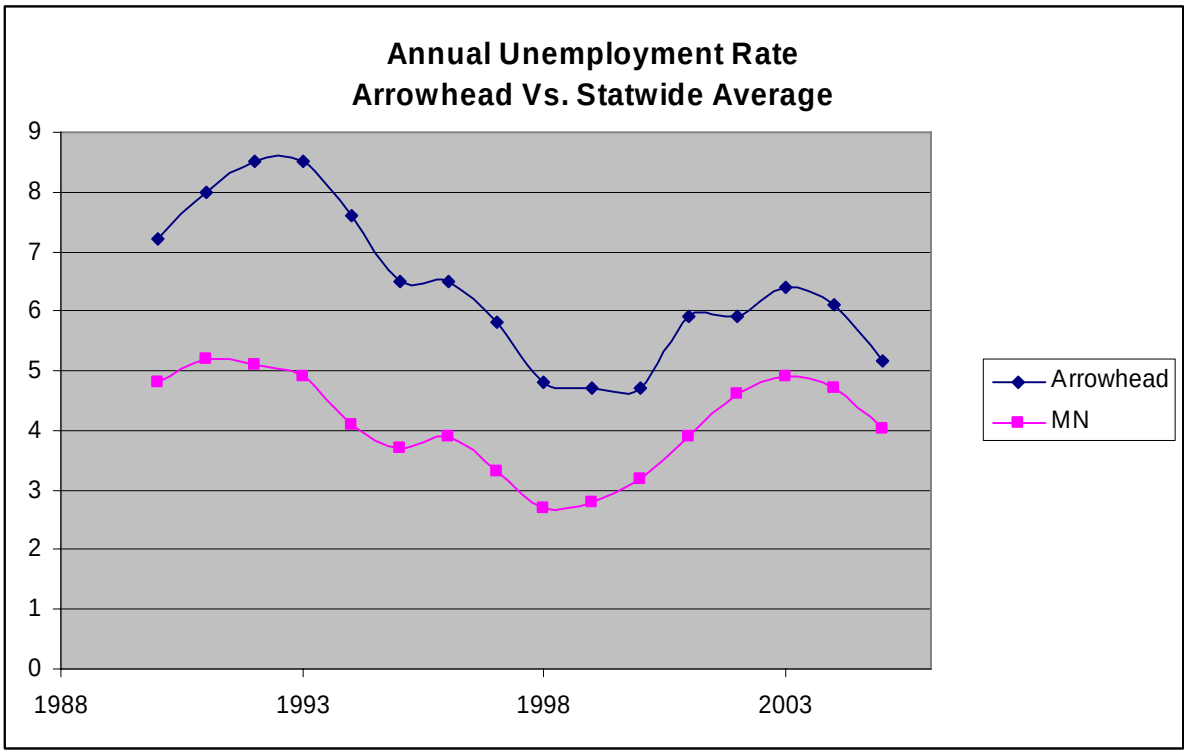
Northeastern Minnesota has historically relied on the mining and forestry industries for well-paying jobs and economic base. However, since 1970 job loss in these two industries and other changes have forced a diversification in employment. Between 2000 and 2003, jobs in mining declined by 36% (DEED, 2005). Although the mining and forestry industries have stabilized recently, both industries are now producing more output with fewer employees. These changes and the general economic crisis of the 1980's have forced the region to adopt economic diversification as a long-term strategy.

DEED collects employment data for the state of Minnesota. The 2003 data show that, as in the rest of the country, employment in the service sector is an increasingly large percentage of total employment in the Arrowhead Region. Mining now accounts for only 3% of the employment in the region, but accounts for 5% of wages paid. This indicates that mining and manufacturing jobs, while no longer a large percentage of regional employment, pay significantly higher wages than most service jobs in the area. Mining and paper production are still the two highest output industries in the region on a dollar value basis (BBER, 2005). Although mining and forestry jobs account for only a small percentage of regional jobs, these industries still account for over 15% of the jobs in Taconite (West Range Site) and Hoyt Lakes (East Range Site), both of which are located in historic mining areas of the Iron Range.

6.1.8 Unemployment

Since both temporary construction and permanent employment for the Project would be drawn from throughout the region, this section addresses regional unemployment rates. The average unemployment rate in the seven-county region averaged about 5.1% in 2005, but dropped to about 4.0% over the last four months of the year. Unemployment in the region has gradually declined over the last several years, but since 1990, the regional unemployment rate has ranged from just under 5% to over 8% annually. As shown in Figure 6.1-1, since 1980 the official unemployment rate in the Arrowhead Region has been consistently about 2% higher than the state average, and about 1% higher than the state average for the last five years. Unemployment has also dropped statewide and continued economic expansion in other areas of the state will likely increase the employment disparity between the Arrowhead Region and other parts of the State.

Figure 6.1-1



Unemployment is generally higher in most of the Arrowhead Region compared to other parts of Minnesota. This historically persistent higher unemployment rate in the Arrowhead Region suggests that northeastern Minnesota has and will continue to have a skilled labor force available for local employment in 2010 and beyond, unless labor demand from the taconite, other mining, and forest products increases. Unemployment in St. Louis County (East Range Site) and in Itasca County (West Range Site) is higher than the state as a whole. Other parts of the state, with lower unemployment, would potentially require more labor from outside the local area and region than would occur in the Arrowhead Region. The historically higher unemployment in the Arrowhead Region may indicate that any new industrial capacity in the area is likely to not only attract new residents, but also provide long-term employment to currently unemployed skilled labor living in the area.

6.1.9 Income and Poverty Rate

While there are not significant concentrations of poverty in the Arrowhead Region, overall poverty rates are higher and income is lower in the region than in the state as a whole. While the overall poverty rate is higher than the state average, there do not appear to be any substantial concentrations of extreme poverty. The annual per capita household income in the Arrowhead Region in 2003 was about $26,770, with the corresponding figure for Minnesota was significantly higher, at $34,030. As to poverty rates, according to 2000 Census information, about 11.9% of the population in the Arrowhead Region has an income below the poverty line, compared to 8.3% statewide.

The median household income of Taconite is $30,250, with 17% being below the poverty level. The median household income is higher and poverty rate is lower in Hoyt Lakes, where the median household income is $39,490 and 8.9% live below the poverty level.

6.1.10 Project Economic Benefits

BBER estimated the regional and state economic and employment impacts of the Mesaba Project using an economic impact software model called IMPLAN 2.0 (BBER, 2005). BBER modified the inputs and assumptions as necessary for the Arrowhead Region and the State of Minnesota. Detailed modeling assumptions, algorithms, and results are available in the BBER report. In summary, using construction and operating cost and employment estimates provided by the Applicant, BBER used the IMPLAN 2.0 model to predict the secondary (indirect and induced) economic and job multiplier benefits of the Mesaba Project for both the Arrowhead Region and the State of Minnesota. The economic development benefits are similar for either the West Range or East Range Site.

6.1.10.1 Model Inputs

Table 3.14-2 summarizes the major construction cost assumptions that BBER used as inputs to the IMPLAN Model to estimate the additional employment and economic impacts generated by the Project during construction.

Table 6.1-5
Construction Cost Inputs and Jobs for IMPLAN Model, in 1994 Dollars

	Capital Costs	Labor, Rent, Interest, Profits	Total Expenditure	Total Construction Jobs
2007	$ 60,585,936	$ 69,404,248	$ 129,990,184	1,286
2008	127,629,088	146,205,568	273,834,656	2,708
2009	128,577,236	147,291,520	275,868,756	2,728
2010	140,670,992	161,145,744	301,816,736	2,985
2011	27,029,352	30,963,492	57,992,844	574
Total	$ 484,492,424	$ 555,010,572	$ 1,039,502,996	N/A
Note: Jobs are full *and* part time. Current capital costs estimates are higher than those indicated.				

As shown in Table 6.1-5 based on the information provided in early 2005, BBER assumed a total project construction cost of $1.039 billion, consisting of $484.5 million capital costs and $555 million in labor and other costs. (Note that such costs are lower than current estimates.) Assumed construction costs are shown for each year of the expected five-year construction period. Total direct construction jobs are expected to peak in the year 2010 at 2,985 jobs. Note that the IMPLAN 2.0 model does not distinguish between full and part-time jobs, so all job numbers are reported as total jobs—not full-time equivalents.

Table 6.1-6, below, provides the operating cost assumptions used in the IMPLAN 2.0 model, for the start up years of 2010 and 2011, and for a typical operation year.

Table 6.1-6
Operating Cost and Job Inputs Used for
IMPLAN 2.0 model, in 2004 Dollars

	Operating Cost	Wages, Rents, Interest, and Profit	Total Expenditure	Total Operating Jobs
2010	$8,883,032	$21,121,438	$30,004,470	11
2011	79,979,536	190,169,680	270,149,216	96
Typical Year	88,866,144	211,299,648	300,165,792	107
Note: Jobs are full and part time.				

As shown in Table 6.1-6, BBER assumed total project operating expenditures during a typical year to be about $300 million dollars, consisting of $211 million per year in wages, rents, interest and profits, and about $88.8 million per year in fuel, material, and other operating costs. BBER assumed 107 total new jobs (full and part-time) would be directly created to operate the plant.

6.1.10.2 Model Results

In order to understand the IMPLAN model results, the following three terms must be defined: (1) Direct Effects, (2) Indirect Effects, and (3) Induced Effects.

"**Direct Effect**" means the direct expenditures or jobs created by the Mesaba Project. The Applicant provided this information to BBER.

"**Indirect Effect**" means jobs created and spending generated by local companies to provide goods and services to support the project; these jobs may be more likely than construction jobs to come from local area. BBER estimated these data using the IMPLAN 2.0 model.

"Induced Effects" means expenditures and jobs due to increased consumer spending created by increased local and regional disposable income. BBER estimated these data using the IMPLAN 2.0 model.

Table 6.1-7, below, shows the BBER modeled economic output created by the Mesaba Project in the Arrowhead Region for each year of the five-year construction period. Table 6.1-8 shows the BBER modeled number of jobs created. Both the temporary construction jobs and the permanent operating jobs are likely to result in significant induced effects to the local economies near the new facility due to workers' spending in the region. Some of these induced impacts would be long term, resulting in significant benefits to the local economy.

6.1.10.2.1 Construction Period Economic and Employment

Table 6.1-7 shows the IMPLAN 2.0 modeled economic activity expected in the Arrowhead Region during the five-year construction period as a result of the Mesaba Project.

Table 6.1-7
Construction Period Economic and Job Impacts for Arrowhead Region, from IMPLAN Model, in 2004 Dollars

	Direct	Indirect	Induced	Total
Capital Cost	$ 484,492,424	$ 84,512,618	$ 133,386,670	$ 702,391,740
Value Added	$ 555,010,572	$ 94,839,722	$ 220,531,166	$ 870,381,467
Total Output	$ 1,039,502,996	$ 179,352,340	$ 353,917,836	$ 1,572,773,207

These data show that based on estimated direct construction costs of about $1.04 billion, BBER calculates that during construction the Project (Phase I alone) would generate about $179 million in indirect economic activity and $354 million in induced economic activity in the Arrowhead Region, for a total construction period output of about $1.57 billion. This results in a construction period regional output multiplier of about 1.5. (That is, $1.57 billion in total estimated regional output divided by $1.04 million in construction costs.) This construction period economic multiplier remains valid at higher construction costs. That is, if estimated construction costs increase, the modeled regional and state economic activity due to construction would increase proportionately as well.

The IMPLAN 2.0 modeling results for jobs created in the region during project construction are shown below in Table 6.1-8. The IMPLAN model estimates that in addition to 2,985 jobs required directly in the peak construction year of 2010, an additional 1,776 jobs would be indirectly created or induced in the region, for a total of 4,761 temporary construction jobs for the peak year of 2010.

Table 6.1-8
Construction Period Jobs Created in Arrowhead Region, in Total Jobs, Both Full-Time and Part-Time, Based on IMPLAN 2.0 Modeling

	Direct	Indirect	Induced	Total
2007	1,286	217	548	2,051
2008	2,708	457	1,155	4,320
2009	2,728	460	1,163	4,352
2010	2,985	503	1,273	4,761
2011	574	97	245	615
Note: Jobs are counted as full and part-time employment				

In the peak year of 2010, in addition to 2,985 direct construction jobs, 503 new indirect jobs are expected to be created in the region to provide goods and services to the Project itself, distributed across a number of industries, including architectural and engineering services, wholesale trade,

truck transportation, rental and maintenance of heavy machinery, food and beverage services, and insurance and real estate industries. In addition, another 1,273 new induced jobs are modeled to be created due to increased consumer spending in the region, in industries such as wholesale trade, food and beverage services, general merchandise stores, building materials, real estate and healthcare industries. Overall, the Project was estimated to create 4,761 jobs in the region in the peak construction year.

6.1.10.2.2 Operating Period Economic and Employment Impacts

Although the modeled economic and job benefits of project construction are considerable, they would be temporary—extending through about five years, with peak impacts concentrated during a three-year period. (Again, assuming the construction impact of Phase I only.) Construction of Phase II would considerably extend this temporary period and bring additional extended benefits to the region and state. Permanent operating benefits and jobs would last the entire life of the plant. Operating period economic activity impacts for Phase I are shown at Table 6.1-9, followed by the estimate of jobs created in Table 6.1-10.

Table 6.1-9
Total Economic Impacts From IMPLAN Model for Typical Year, Economic Output in 2004 Dollars

	Direct	Indirect	Induced	Total
Operating Costs (raw materials, fuel, other)	$ 88,866,144	$ 12,010,121	$ 16,298,309	$ 117,174,567
Value-Added	211,299,648	11,325,331	26,968,493	249,593,489
Total Output	300,165,792	23,335,452	43,266,802	366,768,056

As shown in Table 6.1-9 based on direct annual operating expenditures of about $300 million per year, BBER estimates that the Phase I Mesaba Project would typically generate an additional $66 million in indirect economic activity ($23 million) and induced spending ($43 million) in the Arrowhead Region. Therefore, the operation period regional multiplier is about 1.2. As described in detail in the BBER Report, the statewide economic multiplier is slightly higher at about 1.28.

Table 6.1-10 summarizes Mesaba One's estimated impact on job creation in the Arrowhead Region.

Table 6.1-10
Operating Period Jobs Created by Project, From IMPLAN Model, Based on 107 Direct Part-Time and Full-Time Jobs at the Plant

	Direct	Indirect	Induced	Total
Typical Year	107	157	134	398

Table 6.1-10 shows that the Applicant expects to need about 107 full and part-time employees to operate Mesaba One. In addition to these direct jobs, the IMPLAN model predicts that the Mesaba One would indirectly create an additional 157 permanent jobs across a number of industries, including architectural and engineering services, wholesale trade, truck transportation, rental and maintenance of heavy machinery, food and beverage services, and insurance and real estate industries. The IMPLAN 2.0 model estimates the Project would generate an additional 134 permanent jobs because of induced impacts from increased consumer spending in local industries such as wholesale trade, food and beverage services, general merchandise stores, building materials, real estate and healthcare industries, for a total regional increase of 398 full and part-time jobs in a typical operating year. As described in the BBER Report, statewide employment estimates are slightly higher than for the region alone.

A decrease in unemployment and increase in worker productivity will generally translate into higher individual incomes. Such enhanced incomes, in turn, result in reductions in poverty, unemployment benefits, and crime rates, all of which require more public spending for law enforcement activities, social benefits, and health care and other support costs. Researchers have found evidence that unemployment also negatively affects physical and psychological well-being (such as increased alienation, low self esteem, and depression). Such conditions discourage workers from actively searching for work and result in higher poverty rates. These, along with the added disadvantage of lower tax revenues, have a negative impact on local, state and federal fiscal positions. A reduction in unemployment is also likely to contribute to an overall reduction in the high poverty rate in the region, which currently is higher than the statewide rate.

Although the region is currently experiencing a boom due to higher worldwide iron ore demand, some experts in the area believe that this may be transitory. Long-term trends in unemployment in St. Louis or Itasca Counties indicate that there is greater potential for socioeconomic benefits from the development of a large industrial project like the Mesaba Energy Project, as compared to other areas of the State of Minnesota. In addition, new regional mining projects will need additional electric energy, and regional diversification from energy development in the Arrowhead Region is likely to be economically beneficial for the region and the State.

6.1.11 Effects on Land Based Economies

The IGCC Power Station will generally have neutral or positive effects on area land-based economies. Although portions of the West Range and East Range soils are classified as Prime Farmland, no agricultural activity has occurred at either site in recent history.

Timber harvesting is the primary land use that has impacted the Buffer Land and has influenced the composition and dynamics of the forest cover. Both clear cutting and selective harvesting of timber have occurred on tracts of land within the East Range Footprint and Buffer Land, resulting in a patchwork like pattern of cleared recently cut areas and stands of forest cover of varying ages and compositions. All of the East Range uplands are vegetated with northern mesic mixed forest – aspen birch forest (balsam fir subtype). In 2004 or 2005, a sizable portion of the site's upland forest cover was cut for timber production. The remaining forest cover is relatively young, with those lands having been harvested within the past 25 years. There is no old growth forest cover within either the West Range or East Range Footprints or Buffer Lands.

Opportunities for harvesting timber will be investigated as part of the clearing of the sites, routes and utility and transportation corridors. The IGCC Power Station Footprint will take a relatively small acreage out of potential timber production, but Buffer Land is expected to be generally undisturbed.

Area tourism is not expected to be adversely impacted by the IGCC Power Station. The Hill-Annex State Park will benefit from the IGCC Power Station being operated at the West Range Site because the water levels in the Hill-Annex Mine Pit would be better managed in conjunction with the IGCC Power Station's water management plan. Also, once the Station is placed into commercial operation, it is expected to attract visitors from around the world given its deployment of state-of-the-art technology. The IGCC Power Station is also likely to attract future research and development investments relating to hydrogen, greenhouse gases, coal-to-liquids, and other synergistic industries.

The mining industry will not be adversely impacted by the IGCC Power Station. At the East Range, the IGCC Power Station may benefit the development of proposed mining projects in the area. The IGCC Power Station water needs may present an economical and environmentally preferred means for disposing of excess water generated from those proposed mining operations. Additionally, at some future date the IGCC Power Station could be the source of substitute natural gas as the taconite and other industries search for solutions to the high cost and declining availability of natural gas, a critical component to their production processes and cost structures.

6.2 ELECTRIC AND MAGNETIC FIELDS

High-voltage AC transmission lines produce extremely low frequency (60 hertz) alternating electric and magnetic fields. Electric fields are lines of force exerted on electrically charged particles. Electric fields are measured in units of volts/meter. Magnetic fields, on the other hand, are lines of force exerted on moving charged particles (current). Magnetic flux density is measured in units of gauss, or milligauss.

Magnetic fields are generally considered to have more potential for affecting human health than electric fields, in part because electric fields are more easily reduced by shielding. The intensity of the electric field is related to the voltage of the line. However, the intensity of the magnetic field is directly related to the amount of current flowing through the conductors, not the voltage. Therefore, a higher-voltage transmission line does not necessarily produce stronger magnetic fields than lower voltage lines. (See predicted fields data in Section 4.4, above).

6.2.1 Regulatory Limits

In the United States there are no federal standards limiting occupational or residential exposure to 60 Hz EMF. Six states have set standards limitations for electric fields (Florida, Minnesota, Montana, New Jersey, New York and Oregon), and two states (Florida and New York) have established standards for magnetic fields, as shown in Table 6.2-1

Table 6.2-1. State Transmission Line Standards and Guidelines

State	Electric Field		Magnetic Field	
	On ROW	Edge ROW	On ROW	Edge ROW
Florida	8 KV/m [a]	2 KV/m		150 mG[a] (max load)
	10 KV/m [b]			200 mG[b] (max load)
				250 mG[c] (max load)
Minnesota	8 KV/m			
Montana	7 kV/m	1 KV/m [e]		
New Jersey		3 KV/m		
New York	11.8 KVB/m	1.6 KV/m		200 mG (max load)
	11 KV/m [f]			
	7 KV/m [d]			
Oregon	9 KV/m			

a For lines of 69-230 KV b. For 500 KV lines c. For 500 KV lines in certain existing ROW
d. Maximum for highway crossings e. May be waived by the landowner f. Maximum for private road crossings

The applicable electric field maximum in Minnesota is 8 kV/m. Predicted electric fields at the centerline in the right-of-way for the proposed high-voltage transmission lines are shown in Section 4 (Tables 4.4-1 through 4.4-5). The predicted electric fields are all less than one-fifth the applicable regulatory maximum.

6.2.2 EMF Health Concerns

Some initial epidemiological studies of 60 Hz EMF levels showed a weak but possible correlation between magnetic fields and childhood leukemia. However, after over twenty years of research there is general scientific consensus that there is no evidence that power line EMF causes biological responses and adverse health effects in humans. Recent research indicates:

- There is little evidence that power lines are associated with an increase in cancer.
- Laboratory studies have shown little evidence of a link between power-frequency fields and cancer.
- An extensive series of studies have shown that life-time exposure of animals to power-frequency magnetic fields does not cause cancer.
- A connection between power line fields and cancer is physically implausible.

In 1999 the National Institute of Environmental Health Sciences (NIEHS) issued its final report on “Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields” in response to the 1992 Energy Policy Act. NIEHS concluded that the scientific evidence linking EMF exposures with health risks is weak and that this finding does not warrant aggressive regulatory concern.

In 2002, Minnesota formed an Interagency Working Group to evaluate the body of research and develop policy recommendations to protect the public health from any potential problems resulting from High Voltage Transmission Lines (HVTL) EMF effects. The Working Group consisted of staff from the Department of Health, the Department of Commerce, the Public Utilities Commission, the Pollution Control Agency, and the Environmental Quality Board. The Department of Health coordinated the activities of the Working Group. In September 2002, the Working Group published its findings in a White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options (White Paper). The following summarizes the findings of the Working Group:

> Research on the health effects of EMF has been carried out since the 1970's. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most concluded that there is insufficient evidence to prove an association between EMF and health effects; however many of them also concluded that there is insufficient evidence to prove that EMF exposure is safe. (EMF White Paper, 2002).

Similar conclusions were reached by the Public Service Commission of Wisconsin in its extensive review in the Arrowhead-Weston Electric Transmission Line Project EIS proceeding (October 10, 2000).

Despite this general consensus, however, there are still some concerns. For example, California's Department of Health Services (DHS) published a report by the California EMF Program in 2002 that concluded there was a weak but probably real association between EMF and cancer. The California panel reached this conclusion having reviewed the same information as other researchers, but using a decision-making approach that was radically different from that utilized elsewhere.

Also, on June 3, 2005, the British Medical Journal released a paper entitled "Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study" (Draper 2005). This paper contained findings from a study on childhood cancer carried out by Oxford University that analyzed and compared 33 years of data (from 1962 to 1995) on 29,000 children diagnosed with cancer. The study found slightly elevated rates of childhood leukemia in children whose residence at birth was close to power lines. Proponents of the EMF health connection have argued that the magnetic fields produced by the power lines are responsible for this correlation. However, the British study found elevated rates of childhood leukemia at distances out to 600 m from the lines. At such distances, the magnetic fields in homes due to power lines are negligible compared to existing background levels. Moreover, the authors of the study found no causal link between childhood leukemia and EMF, stating "we emphasize again the uncertainty about whether this statistical association represents a causal relation." In addition, the authors state "neither the association reported here nor previous findings relating to level of

exposure to magnetic fields are supported by convincing laboratory data or any accepted biological mechanism."

There are many sources of more detailed information on the potential health effects of EMF. For example, the Minnesota Department of Heath maintains information on its web site: http://www.health.state.mn.us/divs/eh/radiation/emf/index.html. Another extensive site maintained by a University of Wisconsin Medical research faculty is found at: http://www.mcw.edu/gcrc/cop/powerlines-cancer-FAQ/toc.html#19N

6.2.3 Prudent Avoidance

Although researchers have found no mechanism for EMF to cause cancer and studies have not shown a consistent association between power lines and health impacts, it is difficult to conclusively state that there is no impact. Therefore, most regulatory agencies and other organizations have promoted a "prudent avoidance" policy. (See, e.g., Minnesota Working Group on EMF White Paper, 2002). The Minnesota Working Group White Paper concludes that passive regulatory action, such as providing public education and reducing magnetic fields when possible, is warranted.

6.2.4 Predicted Electric and Magnetic Fields

Predicted electric and magnetic fields for typical 345 kV and 345 kV/115 kV double circuit lines for this Project are described and shown in Section 4.4 above. The predicted EMF for the proposed double circuit 345 kV line on the West Range Site is also shown below in Figure 6.2-1. The predicted levels decrease rapidly away from the centerline, reaching approximately background levels of 2 mG (background) at 300 feet or less from the proposed transmission lines. Subject to final design, these predicted EMF levels reflect the mitigation designs described below.

6.2.5 Mitigation Measures

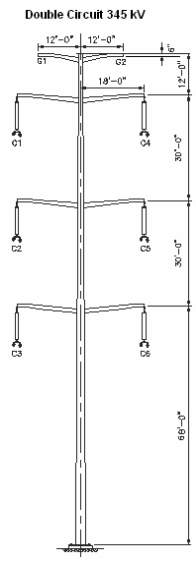
Consistent with the prudent avoidance policy described above, the Applicant has evaluated and will be implementing all reasonable mitigation methods to reduce EMF exposure. The three primary methods to be employed to reduce EMF are explained below.

Distance. The amount of EMF exposure is directly related to distance from the transmission line. The strength of both the electric and magnetic fields from transmission lines is inversely proportional to the square of the distance from the source conductors. Route options and designs have been selected in part to avoid residences to the extent possible. Also, the proposed right-of-way and structure heights for the HVTL lines have been designed to minimize EMF and to keep EMF exposure within appropriate ranges, as is shown in Figures 4.6-1 through 4.6-10. The Applicant will strive to route the transmission line the greatest distance practicable from residences and minimize impacts to farm outbuildings

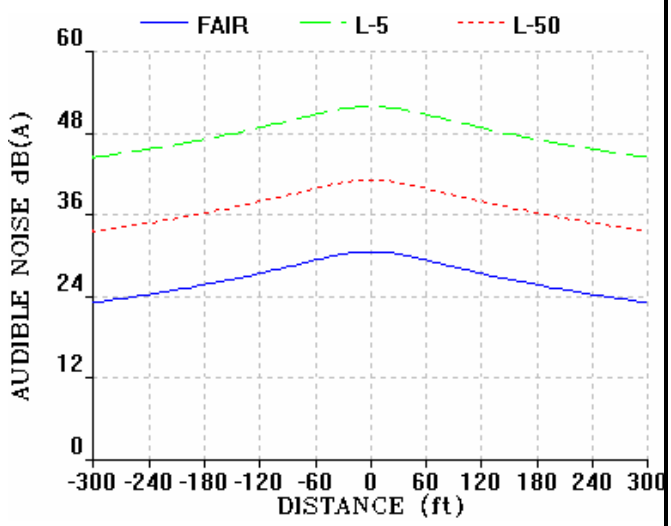
Compaction. The configuration and distance between phases has an impact on EMF exposure. The amount of EMF exposure is reduced when the phases are compacted. A single circuit compacted triangular configuration has been adopted for both the West Range and the East Range to keep the EMF influence below the limits established by the EMF Standards.

Phase cancellation. Phase cancellation significantly reduces EMF from transmission lines. For the 230 kV double vertical circuit lines, the phase arrangement ABC-CBA reduces the magnetic field by approximately three times in comparison with an ABC-ABC arrangement as shown in Figure 6.2-2. The Phase I operation of the 345 kV double circuit phase arrangement can be adjusted in such a way to reduce the magnetic field by approximately 45%. The phase arrangement mitigation for the 345 kV line with 115 kV underbuild results in an approximate three-fold reduction in EMF relative to the unmitigated arrangement.

Figure 6.2-1 EMF Calculations for Double 345 kV Line



Audio Noise



Magnetic Field

Electric Field

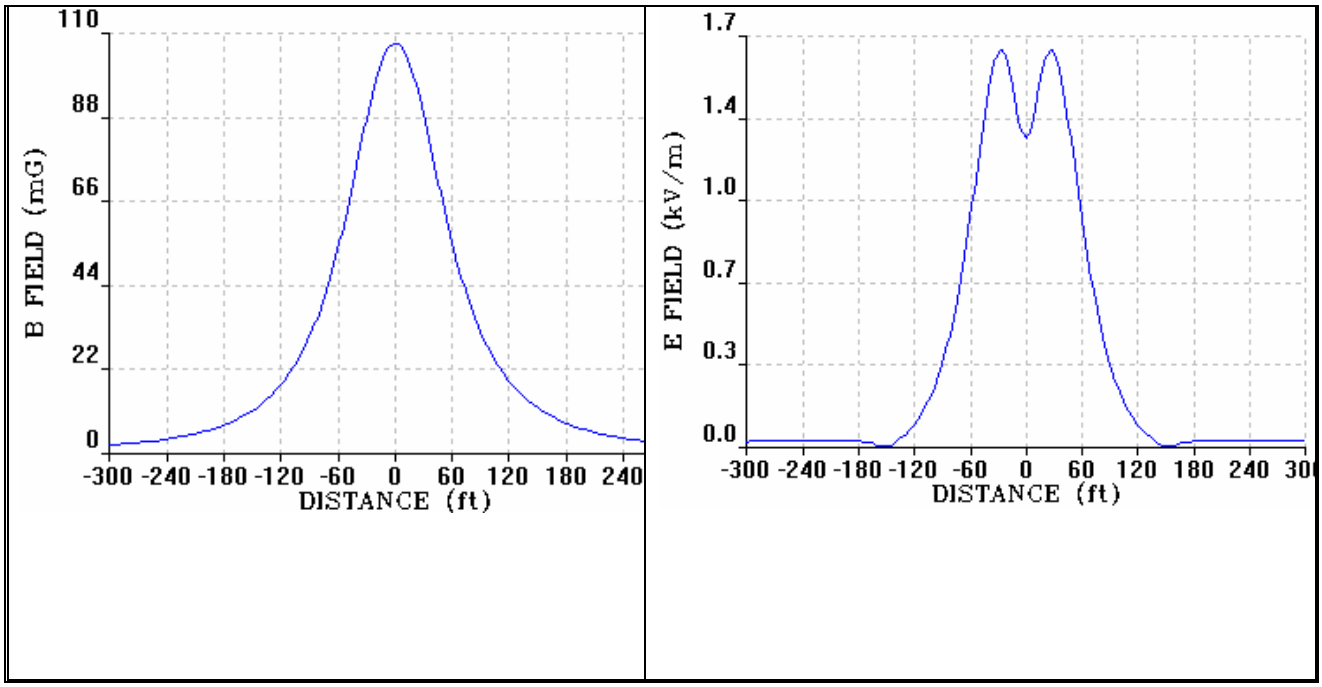
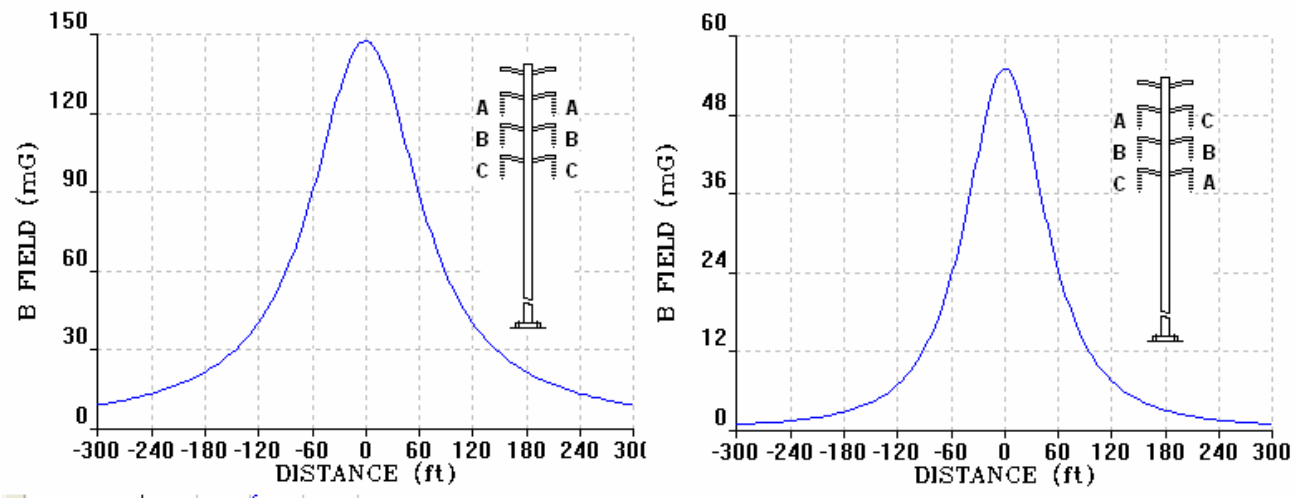


Figure 6.2-2 Phase Arrangement Comparison for 230 kV Line 2 CKT



For the 230 kV double vertical circuit lines with the 115 kV line underbuild, the phase arrangement ABC-CBA-ABC_{115} reduces the magnetic field by more than 2 times in comparison with the ABC-CBA-CBA_{115} arrangement as illustrated in Figure 6.2-3.

Figure 6.2-3 Phase Arrangement Comparison for 230 kV Line 2 CKT–115 kV Line Underbuild

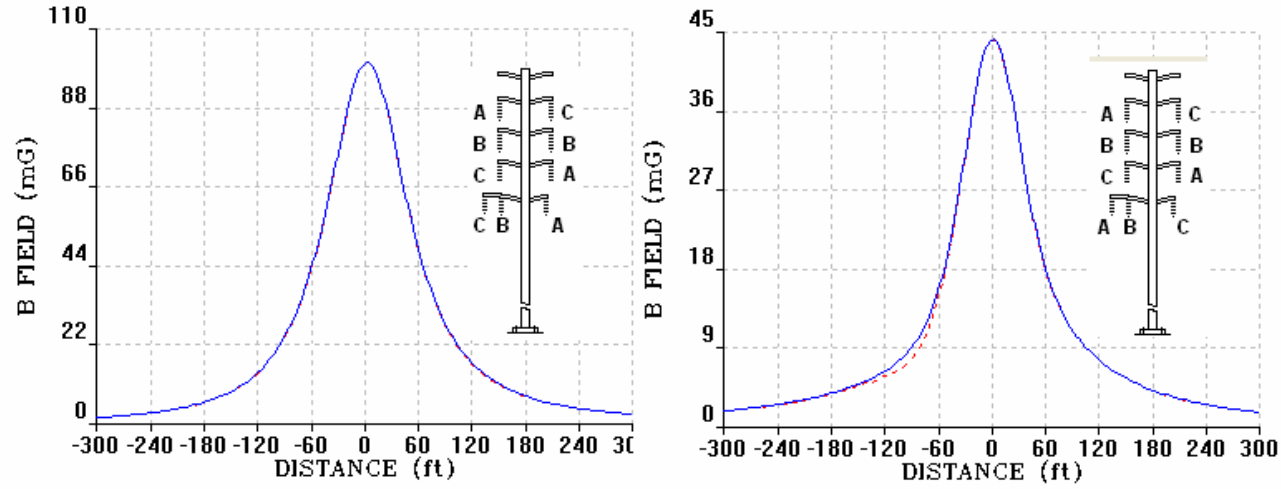
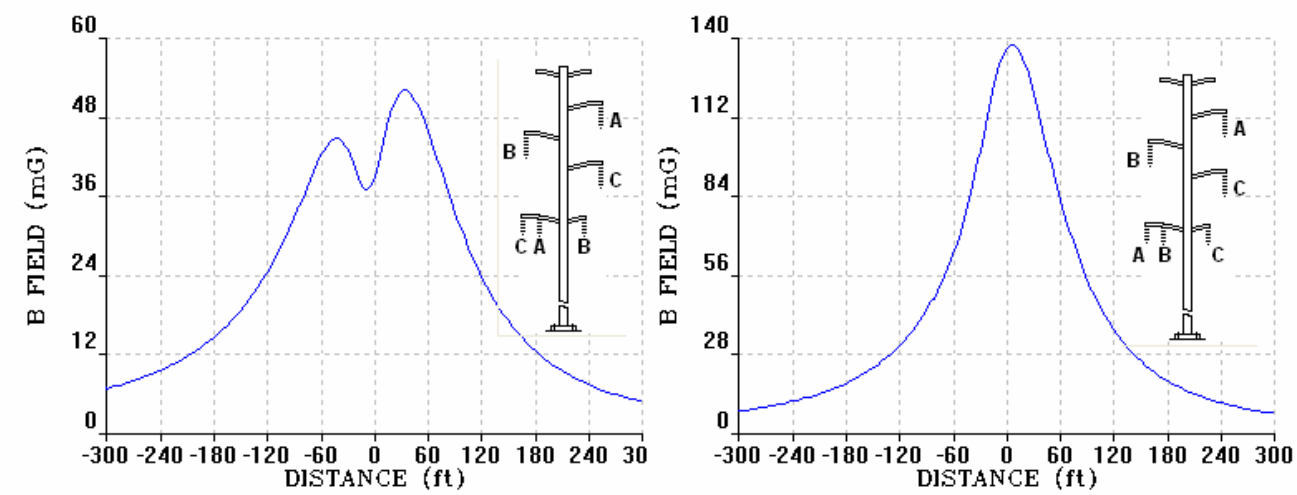


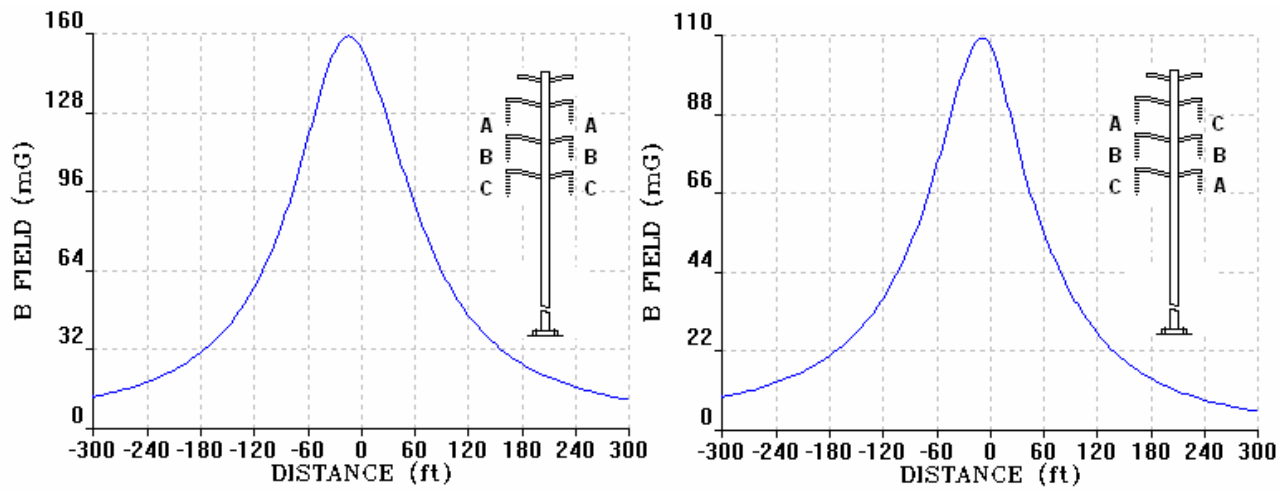
Figure 6.2-4 shows a reduction of the magnetic field by approximately 3 times when comparing the configuration ABC-CAB with the arrangement ABC-ABC of the 345 kV triangular structures with 115 kV circuit underbuild.

Figure 6.2-4 Phase Arrangement Comparison for 345 kV Line with 115 kV Underbuild



An approximately 45% reduction of the magnetic field can be achieved when the vertical phasing ABC-ABC is changed to the vertical arrangement ABC-CBA on the 345 kV line with parallel 115 kV line, as shown in Figure 6.2-5.

Figure 6.2-5 Phase Arrangement Comparison for 345 KV Line with Parallel 115 kV



6.2.6 Minimum Setback Requirements

New or renovated high-voltage transmission lines must comply with the most recently published edition of the National Electric Safety Code (NESC), as published by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and approved by the American National Standards Institute (Minn. Stat. § 326.243 and Minn. R. 7826.0300, subp. 1).

The Applicant will comply with local, state, NESC, and other applicable utility standards regarding the installation of facilities, clearance to ground, clearance to crossing utilities, clearance to buildings, strength of materials, and ROW widths. The Applicant will use more conservative clearances than the NESC requirements in cases where it has determined the need for additional clearances to protect facilities from damage. Some clearances are mandated by the Minnesota Department of Transportation (Mn/DOT). A list of applicable standards are included for the 345 kV transmission is provided in Table 6.2-2 below.

Frequently asked questions about the NESC standards are available on the IEEE website at: http://standards.ieee.org/faqs/NESCFAQ.html.

Table 6.2-2
NESC Clearances for 345 kV Transmission Lines

Condition	NESC minimum clearance to conductor
Roads, streets, agricultural lands, forests traversed by vehicles	24’-9” (vertical)
Water areas not suitable for sail boating	23’-3” (vertical)
Water areas suitable for sail boating – 20 to 200 acres	39’-9” (vertical)
Water areas suitable for sail boating – 200 to 2000 acres	45’-9” (vertical)
Building roofs not accessible to pedestrians	18’-9” (vertical)
Building roofs accessible to pedestrians	19’-9” (vertical)
Building walls, projections, balconies	10’-9” (horizontal)
Grain Bin vertical clearance	18’ above highest fill point
Grain Bin horizontal clearance	Highest bin height + 18’
Tree vertical clearance	No specific requirement
Tree horizontal clearance	No specific requirement