Prepared for:

Minnesota Steel Industries, LLC
Nashwauk, Minnesota

2007 Canada Lynx Assessment

Final Report

ENSR Corporation
April 2007
Document No. 00738-001-120

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Executive Summary

We studied Canada lynx (lynx) abundance, movement, and habitat use in the vicinity of the proposed Minnesota Steel Industries, LLC (Minnesota Steel) mine project site in Itasca County, Minnesota. Lynx are a federally-listed threatened species. The mine project site is in the core area used by lynx in Minnesota. Voyageur National Park, 75 miles (120 kilometers) north of the mine project site, has been designated as critical habitat for lynx by the U.S. Fish and Wildlife Service. Information collected during this study will support mine project environmental review and permitting efforts and help identify additional data collection requirements. The information also supports federal Endangered Species Act consultation for the proposed project.

Minnesota Steel proposes to reactivate the former Butler Taconite mine and tailings basin, and to add ore processing, direct-reduced iron production, and steel making in an integrated facility. The mine project would affect approximately 3,200 to 3,700 acres (1,295 to 1,500 hectares; ha) of wildlife habitat, depending in part on the location of the tailings basin. Wildlife habitat on the project site includes second-growth forest habitat and wetlands. One of the concerns brought up during public scoping for the project was the potential for the project to adversely impact wildlife species of concern, specifically the lynx, and their habitat.

The primary study area extended out approximately 6 miles (10 km) from the proposed mine project area. This area encompassed much of the home range of lynx that might have occurred near the project site. Within this area, surveys were primarily conducted in the following seven townships: Township 56 North, Ranges 21, 22, 23 and 24 West; and Township 57 North, Ranges 22, 23, and 24 West. This area is approximately 250 mi^2 (648 km^2). In addition, some time was spent conducting lynx surveys in other townships in or adjacent to the study area.

Field surveys for lynx and other felids (bobcat and mountain lion) were conducted during January through March 2007. Approximately 541 miles (870 km) of transect were surveyed in the study area, and 73 miles (117 km) were surveyed in other townships in or adjacent the study area.

We did not observe lynx or their sign in the study area. Bobcat track intercepts were recorded at 56 locations in 5 survey townships and in 2 townships adjacent the study area. We submitted four scat for DNA analysis to determine species, sex, and identity; all scats were collected within the study area. Based on DNA analysis of these samples, four unique bobcats were identified and none of the four individuals was an F1 lynx-bobcat hybrid.

We observed habitat that was marginally suitable for lynx in all townships of the study area. Although lynx have been observed near the study area in the past, most patches of suitable lynx habitat are separated from each other and are probably not large enough to support lynx reproduction and lynx use for extended periods of time. However, two areas appear to have enough suitable habitat to support lynx use for shorter periods of time.

The proposed project may affect lynx found in the vicinity of the project site, but the project would not adversely affect lynx populations or their critical habitat. Lynx likely do not reside in the study area. However, lynx could travel through the area and it is reasonably foreseeable that mine project activities could impact movements through the area. Proposed conservation measures, including reclamation of the mine project site, would eventually restore lynx and other wildlife habitat to the site.

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1.1 Introduction

We studied Canada lynx (lynx; *Lynx canadensis)* abundance, movement, and habitat use in the vicinity of the proposed Minnesota Steel Industries, LLC (Minnesota Steel) mine project site in Itasca County, Minnesota (Figure 1). Lynx are a federally-listed threatened species. The project is in the core area used by lynx in Minnesota. Information collected during this study will support mine project environmental review and permitting efforts and help identify additional data collection requirements. The information also supports federal Endangered Species Act consultation for the proposed project.

Minnesota Steel proposes to reactivate the former Butler Taconite mine and tailings basin, and to add ore processing, direct-reduced iron production, and steel making in an integrated facility. The proposed project would utilize an existing tailings basin (Stage I Tailings Basin) for the discharge of new tailings (Figure 2; Minnesota Department of Natural Resources [MNDNR] 2005a).

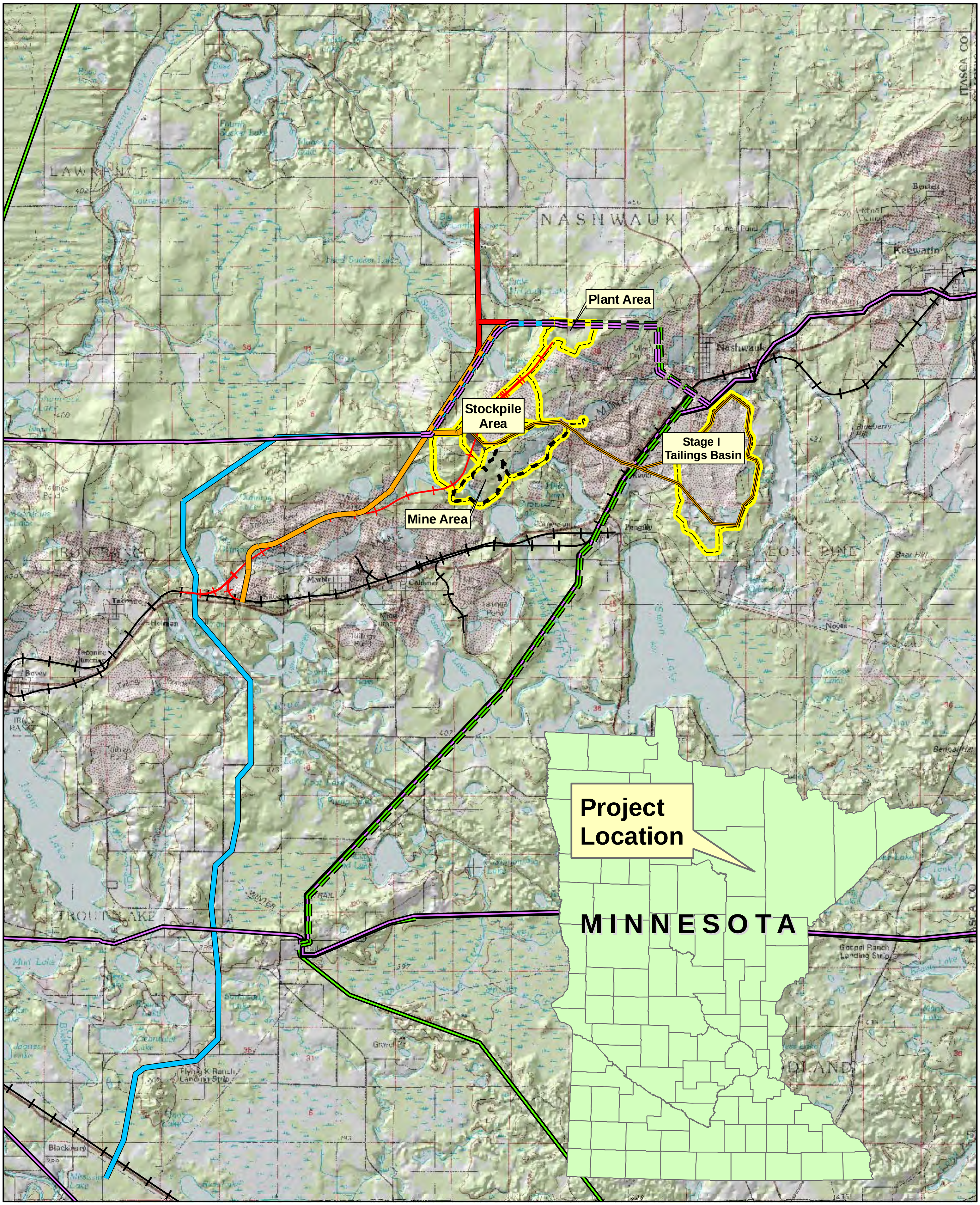
The project would affect approximately 3,200 to 3,700 acres (1,295 to 1,500 hectares; ha) of wildlife habitat, depending in part on the location of the tailings basin. Wildlife habitat on the project site includes second-growth forest habitat and wetlands. One of the concerns brought up during public scoping for the project was the potential for the project to adversely impact wildlife species of concern, specifically the lynx (MNDNR 2005b).

Canada lynx in the contiguous United States are at the southern margins of a widely distributed lynx population that is most abundant in northern Canada and Alaska (Figure 3). On March 24, 2000, the lynx was federally listed as a threatened species in several states in the Northeast, Great Lakes Region (including Minnesota), and Southern Rockies. On November 9, 2006, the U.S. Fish and Wildlife Service (USFWS) designated 317 square miles (mi^2; 822 square kilometers [km^2]) as critical habitat in Voyageurs National Park (Federal Register 2006). Voyageurs National Park is approximately 75 miles (120 km) from the proposed mine project site. The lynx is afforded no special status under Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895), which requires the MNDNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern.

Several unverified sightings of the lynx have been reported near the project site since 2000, including one within approximately 5 miles (8 km) of the project site (MNDNR 2007). The nearest verified record was about 10 miles (16 km) from the site. As the home range of the lynx is generally about 30 mi^2 (78 km^2), it is possible that one or more lynx could use habitat associated with the project site.

1.2 Study Purpose

This project would impact over 3,000 acres of habitat used by wildlife, including lynx. Loss of habitat was identified as an important issue during scoping and by state and federal agencies during meetings regarding the proposed project. Information contained in this assessment will be used during preparation of the Environmental Impact Statement for the project to describe baseline conditions and potential effects to lynx from the project. Information will be used to support project permitting efforts and to identify additional data collection requirements. In addition, this assessment will support consultation with the USFWS for actions that require consultation under Section 7 of the federal Endangered Species Act (ESA; the Act) of 1973, as amended (19 U.S.C. 1536 [c], 50 CFR 402.14[c]). The purpose of the Act is to provide a means for conserving the ecosystems upon which threatened and endangered species depend, and to provide a program for protecting these species. As part of consultation, the USFWS requested that Minnesota Steel survey for lynx near the proposed project site to better determine their occurrence, abundance, and habitat use on or near the proposed project site.



Barr Footer: Date: 1/4/2007 5:36:11 PM File: I:\Client\MSI\Lynx_Study\Maps\Report\Figure 1 Project Location.mxd User: TJA

Project Areas
Tailings Pipeline
Existing Railroads
Proposed Rail Alignment*
Road Alignment - Option 1*
Road Alignment - Option 2*
Preferred Gas Alignment*

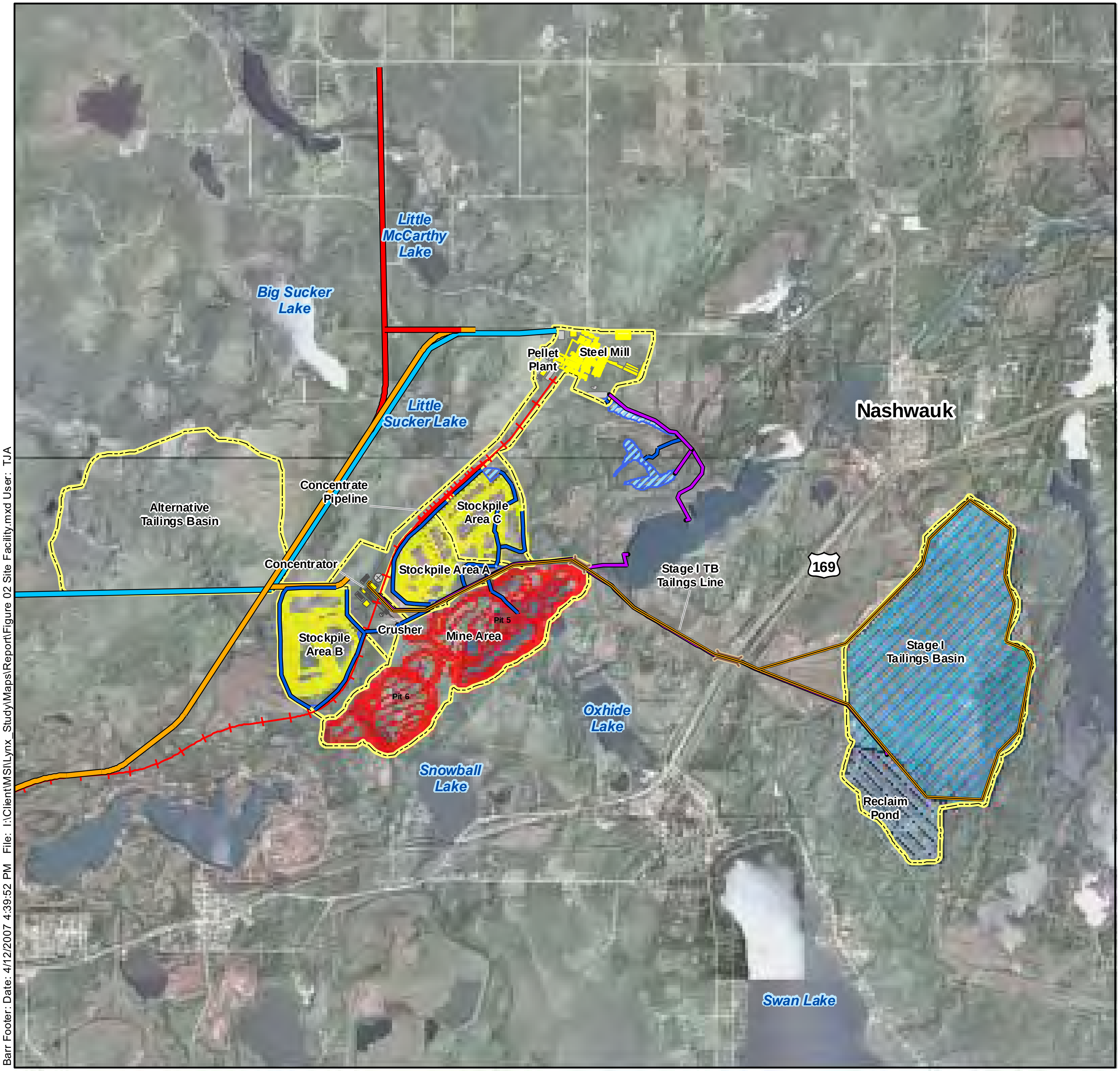
Approximate Power Line Alignment

115KV New
230KV New
115KV Existing
230KV Existing

*Source:, SEH

Miles
0.5 0 0.5 1 1.5 2

Figure 1
PROJECT LOCATION
Minnesota Steel Industries

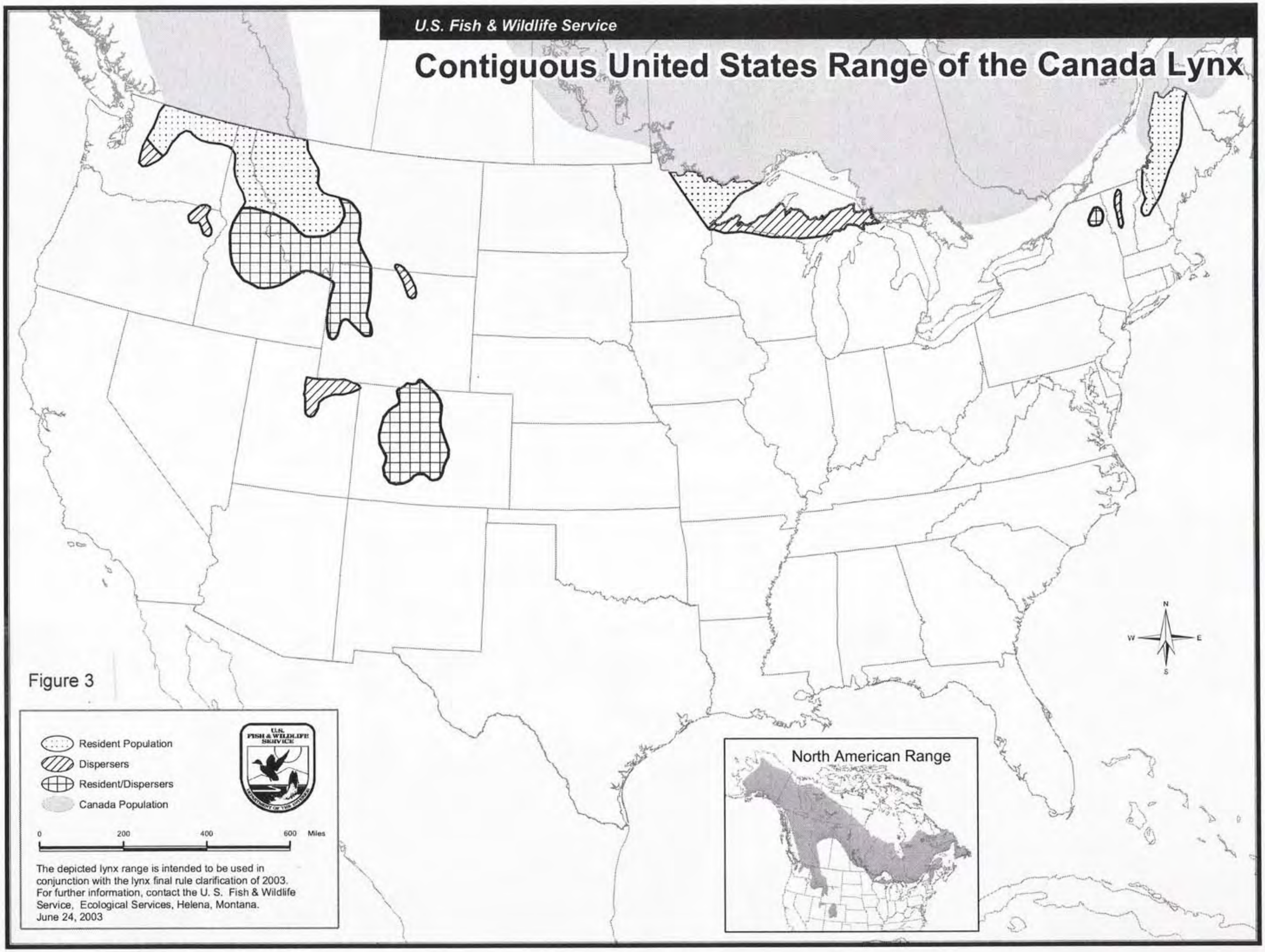


Miles
0 0.5 1

- Tailings Pipeline
- Water Supply/Reclaim Pipeline
- Stormwater Pipes/Ditches
- Proposed Rail Alignment*
- Road Alignment - Option 1*
- Road Alignment - Option 2*
- Preferred Gas Alignment*
- Project Area Outlines
- Stormwater Ponds

*Source: SEH
2003 FSA Aerial Photography

Figure 2
SITE FACILITY
Minnesota Steel Industries


U.S. Fish & Wildlife Service
Contiguous United States Range of the Canada Lynx
Figure 3
Resident Population
Dispersers
Resident/Dispersers
Canada Population
U.S. FISH & WILDLIFE SERVICE
0
200
400
600
Miles
The depicted lynx range is intended to be used in conjunction with the lynx final rule clarification of 2003. For further information, contact the U. S. Fish & Wildlife Service, Ecological Services, Helena, Montana. June 24, 2003
North American Range
N
W
E
S

2.0 PROPOSED ACTION AND STUDY AREA

2.1 Introduction

Minnesota Steel proposes to reactivate the former Butler Taconite mine and tailings basin area and add direct reduced iron production and steel making and rolling equipment in an integrated facility in order to produce steel directly from Minnesota taconite ore. The area was first mined in 1902, and the former Butler Taconite facility was active from 1967 to 1985.

The purpose of Minnesota Steel's project is to integrate all the steps necessary to make very low cost, high quality sheet steel at the former Butler site. Minnesota Steel's business plan is to make steel from taconite in a cleaner and more efficient manner than traditional steel plants. There would be environmental benefits and production efficiency associated with having a continuous flow of materials, keeping the material at an elevated temperature throughout the process, and eliminating multiple transportation steps.

The project would include construction of new facilities—a crusher, concentrator, pellet plant, plant for producing direct reduced iron (DRI), and a steel mill consisting of two electric arc furnaces (EAFs), two ladle furnaces, two thick slab casters, a hot strip rolling mill, a sheet steel coiler—and refurbishment and use of the former Butler facility tailings basin. Minnesota Steel expects to employ about 700 people for production, support, and administration (MNDNR 2005a).

The ore resource is estimated at about 1.38 billion long tons (1.4 billion metric tons), or about 100 years based on the proposed production capacity. As is typical for mine project financing, project planning and detailed design are only being prepared for the first 20 years. The 20-year plan is the proposed project for the purposes of this environmental review; any proposed project beyond 20 years would require additional environmental review and permitting. Minnesota Steel expects mine development and plant construction to take from 24 to 48 months.

The project would produce about 2.46 million long tons (2.5 million metric tons) per year of hot rolled sheet steel, requiring 3.74 million long tons per year (mlty; 3.8 million metric tons) of taconite pellets or 12.9 mlty (13.1 million metric tons) of taconite ore.

2.2 Mine

The project is based on producing ore from the western portion of the Mesabi Iron Range. This is a major, well-known geologic feature oriented roughly northeast-southwest across more than 100 miles (160 km) of northeastern Minnesota from near Babbitt to near Grand Rapids. The Mesabi Iron Range has been the largest source of iron ore produced in Minnesota since the 19th century, and continues to be the predominant source of iron ore in the United States.

Across the site, bedrock is generally covered by a 25 to 150-foot-thick layer of glacial drift (i.e., soil and rocks deposited during the retreat of the last glaciers). The formation that would be mined is known as the Biwabik Iron Formation, a layer of rock that is roughly 400 to 500 feet (123 to 154 meters) thick. It is the uppermost bedrock unit at the mine site and becomes progressively deeper to the south-southeast, sloping downward at about 7 degrees. The Biwabik Iron Formation is subdivided into four members: Lower Cherty, Lower Slaty, Upper Cherty, and Upper Slaty.

Minnesota Steel would obtain its magnetic taconite ores from a horizon within the Lower Cherty member of the Biwabik Iron Formation. This horizon is typically 180 to 200 feet (55 to 62 meters) thick, roughly equal to 30 to 35 percent of the total formation thickness, and is subdivided into a number of major and secondary units, based on texture, layering, and variable distribution of the iron-bearing mineral suite.

The taconite ore of the Biwabik Iron Formation would be mined by open-pit methods within the general mining outline, as shown in Figure 2. Mining would start at two locations: resumed mining in Pit 5 on the northeast, and initiation of mining in the proposed Pit 6 on the southwest. Mining in Pit 5 would begin on the upper benches of the southern end of the pit and eventually would be expanded in all directions. A saddle would remain between the two pits; this area contains non-iron-bearing rock and low-grade iron ore that cannot be used in Minnesota Steel's concentration process. The saddle has been included in the mining area because it is highly likely to be disturbed in the process of mine development. The maximum depth of mining would be limited by economic conditions as the mine is developed, but it is assumed that it would be to about elevation 1,060 feet (323 meters) above mean sea level (amsl), or roughly 300 feet (92 meters) below the adjacent ground surface.

Minnesota Steel proposes to stockpile overburden, waste rock, and lean ore on and near the old Patrick "B" tailings basin as shown in Figure 2.

After removal of overburden, waste rock and taconite ore would be drilled, blasted, and loaded into mine trucks by diesel-hydraulic shovels. There are both economic and environmental considerations that provide an incentive for efficient blasting practices. Measures that would be used to make blasting as efficient as possible include:

- calculation of proper hole depth and size to contain the energy of explosives
- use of adequate boosters to ensure that the explosive charge is totally detonated
- use of plastic liners in wet holes to avoid mixing portions of the explosive with groundwater
- proper collaring and backfilling of the holes after placement of the explosives to ensure that the energy is contained and directed outward

The raw ore would be trucked to the primary crusher. Waste rock would either be placed in waste rock stockpiles or used to construct dikes and haul roads. During and following each phase of mining, reclamation of the overburden slopes and stockpiles would be completed according to MNDNR mine land reclamation requirements.

2.3 Haul Roads

For mining and stripping operations, Minnesota Steel would use the existing Butler facility haul roads and new haul roads to transport stripping material to the stockpile area and taconite ore from the mine to the crusher. Approximately 3,500 feet (1,067 m) of new road and the in-pit roads would be constructed. Haul road access and ramp construction would require an estimated 325,000 long tons (330,000 metric tons) of crushed rock. As the mine pits are expanded and if in-pit stockpiling begins, existing mine pit and inter-pit haul roads would be utilized. Existing haul road alignments and disturbed areas would be utilized to the greatest extent practicable (Barr Engineering 2006b).

Additional roadways would be constructed to the south to connect with U.S. Highway 169 to provide access for construction activities and truck deliveries. At this time, it is anticipated that employee access during construction and operation would be from the east via Highway 58, which terminates at the plant site. The highest traffic volumes would be during shift changes. Additional service roads would be required along the tailings pipeline and around the perimeter of the tailings facility. Traffic levels on these service roads would be light.

2.4 Crusher, Concentrator, Pellet Plant, and Direct Reduction Plant

The proposed processing plant would consist of a crusher, concentrator, pellet plant, and DRI plant and would be located in Sections 35 and 36 of Township 57 North, Range 23 West. Access to the north and west side of the property by rail and road would be constructed on the west side of the project. The rail layout would allow Minnesota Steel to connect into either the Canadian Northern rights-of-way or the existing Burlington Northern Santa Fe tracks, about 6 miles southwest of the plant site near the town of Taconite (Figure 2).

Crude ore would be trucked from the pits to the primary crusher for size reduction to approximately 12 inches (30 centimeters) in diameter. Additional crushing and magnetic separation (dry cobbing) would occur at the crusher site. The crushed ore would be conveyed to the crude ore stockpile area at the ore concentrator.

The ore concentration and pellet production processes would be similar to existing Mesabi Iron Range taconite plants. From the storage area, crushed ore would be conveyed to the concentrator where the magnetic iron oxide minerals (concentrate) would be separated from the nonmagnetic waste (tailings). In the concentrator, the ore would pass through a series of wet mills that would grind the rock to a flour-like consistency. Magnetic separators would separate the concentrate from the waste rock. Concentrate would be further refined by flotation, which would remove the more silica-rich material, leaving nearly pure iron oxide concentrate. Concentrate would be pumped to the pellet plant. Tailings from the concentrator would be pumped to a tailings thickener where excess water would be removed by sedimentation. The tailings slurry would be pumped to the tailings basin for disposal.

In the pellet plant, wet iron oxide concentrate would be dewatered in vacuum filters, mixed with a binder and limestone, and then converted to unfired pellets in balling drums or disks. The unfired pellets would be moved to an indurating furnace and fired into hardened iron oxide pellets in a straight-grate pellet furnace. The oxide pellets would be size screened and then fed (hot) directly to the DRI plant or stored for future balancing of the production schedules. The undersized pellets would be ground and recycled to the concentrate slurry (or sold as sinter feed).

The DRI facility would convert iron oxide pellets to nearly pure iron pellets. The oxide pellets would be conveyed to the top of a 300- to 425-foot-high (90- to 128-meter high) vertical shaft reactor. The burden (i.e., the packed mass of pellets in the vertical shaft) would move slowly downward through the reactor by gravity and be discharged from the bottom in the form of metallized (chemically reduced) iron pellets.

In the DRI reactor, oxygen in the oxide pellets would be removed by reducing gas, which is generated by catalytic reaction in a reformer. The input to the reformer is a mixture of natural gas and recycled top gas from the reactor. The reformer converts the natural gas to a mixture of hydrogen and carbon monoxide. In the reactor vessel both gases would react with the oxygen in the pellets to create water vapor and carbon dioxide, thereby removing the oxygen from the pellet and converting the iron oxide into metallic iron. When the pellets reached the bottom of the reactor, they would pass through a cooling mixture of natural gas and carbon monoxide, cooling the iron and increasing the carbon content of the pellets. The exhaust gases would preheat the reformer gases in a heat exchanger prior to being exhausted. Most of the DRI product would be hot charged to the steel mill EAFs. Some DRI could be stored cold in surge silos for future balancing of the production schedules.

Typically, pellet and DRI production facilities can slightly exceed nameplate capacity, while steelmaking capacity is relatively fixed by rolling mill capacity and product mix. Therefore, excess DRI may be shipped from the plant.

2.5 Steelmaking Plant

At full capacity, the steelmaking facility would include two EAFs, two ladle furnaces, two thin slab casters, two tunnel furnaces, a vacuum degasser, a hot strip rolling mill, and a sheet steel coiler. The DRI pellets would be melted in batches in the EAFs, along with additives such as carbon and lime. The molten iron from the EAFs would be transferred to the two ladle metallurgy furnaces. In the ladle furnaces, steel would be produced through refining, oxygen blowing, temperature control, and addition of alloying metals. From the ladle furnace, the liquid steel would be transferred to the continuous casters and cast into slabs approximately 8 to 10 inches (20 to 25 cm) thick. These hot slabs would proceed through a tunnel furnace and series of rolling mills where they would be successively rolled to an ultimate thickness as small as 0.04 inches (1 mm). The sheet steel would be coiled for rail or truck shipment.

2.6 Tailings Basin

About 8.3 million long tons (8.4 million metric tons) of tailings from the concentrating process would be pumped as slurry to the tailings basin per year. For the life of the mine, an estimated 150 million long tons (152 million metric tons) of tailings storage would be required. Minnesota Steel's preferred basin location is the former Butler Stage I basin. An alternative basin (Alternative Tailings Basin) has also been designated. Further evaluation of these alternatives would be considered as part of the Environmental Impact Statement for the project. In either basin, low starter dams would be used as necessary to contain the initial tailings discharge and direct it toward the center of the basin. The lowest part of the basin would form a reservoir that would function as both a settling pond and a clear water reservoir. Tailings would be disposed of by encircling the perimeter of the basin with disposal lines and building the dams hydraulically. The coarsest tailings would drop out first while fine particles would deposit toward the center. The coarse tailings would be dozed to create a perimeter dam with an overall outer slope of 4 horizontal to 1 vertical. The disposal lines would be raised periodically to the new dam crest pushed up by the bulldozer. The basin would increase in elevation and change shape as tailings disposal proceeded upward in elevation. The end product would be a low hill of tailings that would be revegetated per MNDNR reclamation requirements.

2.6.1 Stage I Tailings Basin

The preferred alternative for disposal of tailings would be to utilize the Stage I Tailings Basin area, where Butler Taconite placed tailings on approximately 1,350 acres (546 ha) of the northwest portion between 1967 and 1985. The Stage I Tailings Basin would cover an area of approximately 1,580 acres (640 ha), including about 1,350 acres (546 ha) of tailings basin and 230 acres (93 ha) of reclaim pond, with a crest elevation of approximately 1,475 to 1,510 feet (450 to 465 meters) amsl. This elevation is approximately 80 feet (25 meters) above the existing starter dams (Barr Engineering 2006b).

2.6.2 Alternative Tailings Basin

An alternative tailings basin site is located about 1 mile (1.6 km) northwest of the proposed mine site. (Figure 2). The basin would be located about 1.6 miles (2.6 km) west of the Minnesota Steel plant facilities The area extends from about ¼ mile southwest of Big Sucker Lake west approximately 1.7 miles (2.7 km) to an area east of a tributary to Sucker Brook. One of the three headwaters streams feeding Sucker Brook would be filled. Several wetlands would be filled, and the natural drainage from the south to the north would be blocked by the basin. Surface drainage from the hill south of the basin would likely be diverted to the west, and drainage from within the blocked wetland swale would likely be diverted to the south. This alternative location has not been disturbed by past mining activities, but has been disturbed by logging activities.

The Alternative Tailings Basin would cover an area of approximately 1,119 acres (453 ha), with a crest elevation of approximately 1,515 feet (466 meters) amsl. Starter dams would be constructed around the north end of the basin to an elevation of 1,400 feet (431 meters) amsl. The tailings basin area as shown includes approximately 100 feet (31 meters) around the perimeter for construction of a seepage collection and diversion channel system. The basin was designed to avoid interference with the transmission line corridor that is located along the south side of the Alternative Tailings Basin location.

3.0 STATUS OF THE CANADA LYNX IN THE UNITED STATES AND MINNESOTA

3.1 Background Documents Used to Prepare Assessment

This section is based on information (and references cited therein) in the *Canada Lynx Conservation Assessment and Strategy* (Ruediger et al. 2000), *Ecology and Conservation of Lynx in the United States* (Ruggiero et al. 2000a), *Endangered and Threatened Wildlife and Plants: Determination of Threatened Status for the Contiguous U.S. Distinct Population Segment of the Canada Lynx and Related Rule; Final Rule* (Federal Register 2000), *Biological Opinion on the Effects of National Forest Land and Resource Management Plans and Bureau of Land Management Land Use Plans on Canada Lynx (Lynx canadensis) in the Contiguous United States* (USFWS 2000), *Endangered and Threatened Wildlife and Plants: Notice of Remanded Determination of Status for the Contiguous U.S. Distinct Population Segment of the Canada Lynx; Clarification of Findings; Final Rule* (Federal Register 2003), *2006 Lynx Assessment Final Interim Report* (ENSR 2006), *Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx* (Federal Register 2006), and *2007 Lynx Assessment Survey Plan* (ENSR 2007).

3.2 Status of the Species

3.2.1 Species and Critical Habitat Description

The lynx is a medium-sized cat with long legs. Adult males average 22 pounds (10 kilograms [kg]) in weight and 33.5 inches (85 cm) in length (head to tail), and females average 19 pounds (8.5 kg) and 32 inches (82 cm; Quinn and Parker 1987). The lynx's long legs and large feet make it highly adapted for hunting in deep snow.

The bobcat *(Lynx rufus)* is a North American relative of the lynx. Compared to the lynx, the bobcat has smaller paws, shorter ear tufts, and a more spotted pelage (coat), and only the top of the tip of the tail is black. The paws of the lynx have twice the surface area as those of the bobcat. The lynx also differs from the bobcat in its body proportions; lynx have longer legs, with hind legs that are longer than the front legs, giving the lynx a ''stooped'' appearance (Quinn and Parker 1987). Bobcats are largely restricted to habitats where deep snows do not accumulate (Koehler and Hornocker 1991). Hybridization (breeding) between lynx and bobcat was first documented in 2002 in Minnesota (Schwartz et al. 2004).

Classification of the lynx (also called the North American lynx) has been subject to revision. In accordance with Wilson and Reeder (1993), the USFWS currently recognizes the lynx in North America as *Lynx canadensis.* The USFWS previously used the scientific name *L. lynx canadensis* for the lynx (Jones et al. 1992). Other scientific names still in use include *Felis lynx* or *F. lynx canadensis* (Jones et al. 1986; Tumlison 1987).

On March 24, 2000, the lynx was federally listed as a threatened species in several states in the Northeast, Great Lakes Region (including Minnesota), and Southern Rockies. On November 9, 2006, the USFWS designated 317 square miles (mi^2; 822 square kilometers [km^2]) as critical habitat in Voyageurs National Park (Federal Register 2006). Voyageurs National Park is approximately 75 miles (120 km) from the proposed mine project site. The lynx is afforded no special status under Minnesota's Endangered Species Statute (Minnesota Statutes, Section 84.0895), which requires the MNDNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of special concern.

3.2.2 Distribution

The historical and present range of the lynx north of the contiguous United States includes Alaska and the portion of Canada extending from the Yukon and Northwest Territories south across the United States border and east to New Brunswick and Nova Scotia. In the contiguous United States, lynx historically occurred in the Cascades Range of Washington and Oregon; the Rocky Mountain Range in Montana, Wyoming, Idaho, eastern Washington, eastern Oregon, northern Utah, and Colorado; the western Great Lakes Region; and the northeastern United States region from Maine southwest to New York (McCord and Cardoza 1982, Quinn and Parker 1987).

In the contiguous United States, the distribution of the lynx is associated with the southern boreal forest, comprised primarily of subalpine coniferous forest in the West and mixed coniferous/deciduous forest in the East (Aubry et al. 2000). In Canada and Alaska, lynx inhabit the classic boreal forest ecosystem known as the taiga (McCord and Cardoza 1982; Quinn and Parker 1987; Agee 2000; McKelvey et al. 2000a). Within these general forest types, lynx are most likely to persist in areas that receive deep snow, for which the lynx species is highly adapted (Ruggiero et al. 2000a).

Lynx in the contiguous United States are part of a larger metapopulation whose core is located in the northern boreal forest of central Canada; lynx populations emanate from this area (Buskirk et al. 2000; McKelvey et al. 2000a, b). The boreal forest extends south into the contiguous United States along the Cascade and Rocky Mountain Ranges in the West, the western Great Lakes Region, and the Appalachian Mountain Range of the northeastern United States. At its southern margins, the boreal forest becomes naturally fragmented into patches of varying size as it transitions into other vegetation types. These southern boreal forest habitat patches are small relative to the extensive northern boreal forest of Canada and Alaska, which constitutes the majority of the lynx range. Lynx are considered “not at risk” in Canada (Committee on the Status of Endangered Wildlife in Canada 2006).

Many of these southern boreal forest habitat patches within the contiguous United States are able to support resident populations of lynx and their primary prey species. It is likely that some of the habitat patches act as sources of lynx (recruitment is greater than mortality) that are able to disperse and potentially colonize other patches (McKelvey et al. 2000b). Other habitat patches act as ‘‘sinks’’ in which lynx mortality is greater than recruitment and lynx are lost from the overall population. The ability of naturally dynamic habitat to support lynx populations may change as the habitat undergoes natural succession following natural or manmade disturbances (i.e., fire, clearcutting). In addition, fluctuations in the prey populations may cause some habitat patches to change from being sinks to sources and vice versa. The term ‘‘resident population’’ refers to a group of lynx that has exhibited long-term persistence in an area based on a variety of factors, such as evidence of reproduction, successful recruitment into the breeding cohort, and maintenance of home ranges. The word ‘‘transient’’ refers to a lynx moving from one place to another within suitable habitat. The word “dispersing’’ refers to lynx that have left suitable habitat for various reasons, such as competition or lack of food. When dispersing lynx leave suitable habitat and enter habitats that are unlikely to sustain them, these individuals are considered lost from the metapopulations unless they return to boreal forest.

3.2.3 Population Dynamics

3.2.3.1 Density

Lynx numbers and snowshoe hare densities in the contiguous United States generally do not get as high as those in the center of their range in Canada, and there is no evidence they ever did so in the past (Hodges 2000a, b; McKelvey et al. 2000a). It appears that northern and southern hare populations have similar cyclic dynamics, but that in southern areas both peak and low densities are lower than in the north (Hodges 2000b). However, it is unclear whether hare populations cycle everywhere in the contiguous United States. Relatively low snowshoe hare densities at southern latitudes are likely a result of the naturally patchy, transitional boreal habitat at southern latitudes that prevents hare populations from achieving densities similar to those of the expansive northern boreal forest (Wolff 1980, Buehler and Keith 1982, Koehler 1990, Koehler and Aubry

1994). Additionally, the presence of more predators and competitors of hares at southern latitudes may inhibit the potential for high-density hare populations with extreme cyclic fluctuations (Wolff 1980). As a result of naturally lower snowshoe hare densities, lynx densities at the southern part of the range rarely achieve the high densities that occur in the northern boreal forest (Aubry et al. 2000).

3.2.3.2 Lynx and Snowshoe Hare Relationships

The association between lynx and snowshoe hare is considered a classic predator-prey relationship (Saunders 1963a, van Zyll de Jong 1966, Quinn and Parker 1987). In northern Canada and Alaska, lynx populations fluctuate on approximately 10-year cycles that follow the cycles of hare populations (Elton and Nicholson 1942; Hodges 2000a, b; McKelvey et al. 2000a). Generally, researchers believe that when hare populations are at their cyclic high, the interaction of predation and food supply causes the populations to decline drastically (Buehler and Keith 1982; Krebs et al. 1995; O'Donoghue et al. 1997). There is little evidence of regular snowshoe hare cycles in the Northeast and southern Quebec (Hoving 2001), but hare populations do fluctuate widely in this region. Hare fluctuations in this region may be more influenced by forest practices, weather, and other ecological factors. Snowshoe hare provide the quality prey necessary to support high-density lynx populations (Brand and Keith 1979). Lynx also prey opportunistically on other small mammals and birds, particularly when hare populations decline (Nellis et al. 1972; Brand et al. 1976; McCord and Cardoza 1982; O'Donoghue et al. 1997, 1998a). Red squirrels *(Tamiasciurus hudsonicus)* are an important alternate prey (O'Donoghue et al. 1997, 1998a; Apps 2000; Aubry et al. 2000). However, a shift to alternate food sources may not sufficiently compensate for the decrease in hares consumed to be adequate for lynx reproduction and kitten survival (Brand and Keith 1979, Koehler 1990, Koehler and Aubry 1994). When snowshoe hare densities decline, the lower quality diet causes sudden decreases in the productivity of adult female lynx and decreased survival of kittens, if any are born during this time; as a result, recruitment of young into the population nearly ceases during cyclic lows of snowshoe hare populations (Nellis et al. 1972; Brand et al. 1976; Brand and Keith 1979; Poole 1994; Slough and Mowat 1996; O'Donoghue et al. 1997; Mowat et al. 2000).

3.2.3.3 Home Range and Dispersal

Lynx require very large areas containing boreal forest habitat. In the Northeast, lynx are most likely to occur in areas containing suitable habitat that were greater than 40 mi^2 (100 km^2; Hoving 2001). The requirement for large areas also is demonstrated by home ranges that encompass many square miles. The size of lynx home ranges varies by the animal's gender and age, abundance of prey, season, and the density of lynx populations (Hatler 1988; Koehler 1990; Poole 1994; Slough and Mowat 1996; Aubry et al. 2000; Mowat et al. 2000). Based on a limited number of studies in southern boreal forests, the average home range is 58 mi^2 (151 km^2) for males, and 28 mi^2 (72 km^2) for females (Aubry et al. 2000). Recent home range estimates from Maine are 27 mi^2 (70 km^2) for males and 20 mi^2 (52 km^2) for females. However, documented home ranges in both the southern and northern boreal forest vary widely from 3 to 300 mi^2 (8 to 800 km^2; Saunders 1963b; Brand et al. 1976; Mech 1980; Parker et al. 1983; Koehler and Aubry 1994; Apps 2000; Mowat et al. 2000; Squires and Laurion 2000). Generally, it is believed that larger home ranges, such as have been documented in some areas in the southern extent of the species' range in the West, are a response to lower-density snowshoe hare populations (Koehler and Aubry 1994, Apps 2000, Squires and Laurion 2000).

Lynx are highly mobile and have a propensity to disperse. Long-distance movements (greater than 60 miles [100 km]) are characteristic (Mowat et al. 2000). Lynx disperse primarily when snowshoe hare populations decline (Ward and Krebs 1985; Koehler and Aubry 1994; O'Donoghue et al. 1997; Poole 1997). Subadult lynx also disperse even when prey is abundant (Poole 1997), presumably as an innate response to establish home ranges. Lynx also make exploratory movements outside their home ranges. Lynx are capable of moving extremely long distances (greater than 300 miles [500 km]; Brainerd 1985; Washington Department of Wildlife 1993; Poole 1997; Mowat et al. 2000); for example, a male was documented traveling 380 miles (620 km; Brainerd 1985). While it is assumed lynx would prefer to travel where there is forested cover, the literature contains many examples of lynx crossing large, unforested openings. The ability of both male and female lynx to disperse long distances, crossing unsuitable habitats, indicates they are capable of colonizing suitable habitats and finding potential mates in areas that are isolated from source lynx populations.

3.2.3.4 Mortality

Common causes of mortality for lynx include starvation of kittens (Quinn and Parker 1987, Koehler 1990), and trapping (Ward and Krebs 1985; Bailey et al. 1986). Lynx mortality due to starvation has been shown in cyclic populations of the northern taiga, during the first 2 years of snowshoe hare scarcity (Pool 1994, Slough and Mowat 1996). During periods of low snowshoe hare numbers, starvation can account for up to two-thirds of all natural lynx deaths. Trapping mortality may be additive rather than compensatory during the low period of the snowshoe hare cycle (Brand and Keith 1979). Hunger-related stress, which induces dispersal, may increase exposure of lynx to other forms of mortality such as trapping and vehicle collisions (Brand and Keith 1979; Carbyn and Patriquin 1983; Ward and Krebs 1985; Bailey et al. 1986).

Predation on lynx by mountain lion (*Felis concolor*), coyote (*Canis latrans*), wolverine (*Gulo gulo*), gray wolf (*Canus lupus*), and other lynx has been observed (Berrie 1974; Koehler et al. 1979; Poole 1994; Slough and Mowat 1996; O'Donoghue et al. 1997; Apps 2000; Squires and Laurion 2000). Squires and Laurion (2000) reported two of six mortalities of radio-collared lynx in Montana were due to mountain lion predation.

3.2.3.5 Interspecific Relationships with Other Carnivores

Buskirk et al. (2000) described the two major competition impacts to lynx as exploitation (competition for food) and interference (avoidance). Of several predators examined (birds of prey, coyote, gray wolf, mountain lion, bobcat, and wolverine), it was deemed that coyotes were the most likely to pose local or regionally important exploitation impacts to lynx, and coyotes and bobcats were deemed to possibly impart important interference competition effects on lynx. Mountain lions were described as interference competitors, possibly impacting lynx during summer and in areas lacking deep snow in winter, or when high elevation snow packs develop crust in the spring.

In southern portions of snowshoe hare range, predators may limit hare populations to lower densities than in the taiga (Dolbeer and Clark 1975, Wolff 1980, Koehler and Aubry 1994). Exploitation competition may contribute to lynx starvation and reduced recruitment. During periods of low snowshoe hare numbers, starvation accounted for up to two-thirds of all natural lynx deaths in the Northwest Territories of Canada (Poole 1994).

Parker et al. (1983) discussed anecdotal evidence of competition between bobcats and lynx. On Cape Breton Island, Nova Scotia, lynx were found to be common over much of the island prior to bobcat colonization. Concurrent with the colonization of the island by bobcats, lynx densities declined and their presence on the island became restricted to the highlands, the one area where bobcats did not become established.

Predation on adult lynx has rarely been observed and recorded in the literature. Predators of lynx include mountain lion, coyote, wolverine, gray wolf, and other lynx. The magnitude or importance of predation on lynx is unknown.

3.2.3.6 Behavioral Response to Humans

Staples (1995) described lynx as being generally tolerant of humans. Other anecdotal reports also suggest that lynx are not displaced by human presence, including moderate levels of snowmobile traffic (Mowat et al. 2000) and ski area activities (Roe et al. 1999).

In a lightly roaded study area in northcentral Washington, logging roads did not appear to affect habitat use by lynx (McKelvey et al. 2000c). In contrast, six lynx in the southern Canadian Rocky Mountains crossed highways within their home ranges less than would be expected (Apps 2000). The latter study area contained industrial road networks, twin-tracked railway, and 2 to 4-lane highways with average daily traffic volumes of about 1,000 to 8,000 vehicles per day.

3.2.4 Habitat Requirements

To understand habitat relationships of lynx one must first understand the habitat relationships of snowshoe hares. Snowshoe hares use spruce and fir forests with dense understories that provide forage, cover to escape from predators, and protection during extreme weather (Wolfe et al. 1982; Monthey 1986; Hodges 2000a, b). Generally, earlier successional (younger) forest stages have greater understory structure than do mature forests and, therefore, support higher hare densities (Fuller 1999; Hodges 2000a, b). Lynx generally concentrate their hunting activities in areas where hare populations are high (Koehler et al. 1979; Parker 1981; Ward and Krebs 1985; Major 1989; Murray et al. 1994; O'Donoghue et al. 1997, 1998a). In Maine, snowshoe hare abundance and lynx occurrence are positively associated with late regeneration forests (forest stands that are growing back 12 to 30 years after being clear-cut and have greater than 50 percent canopy closure), evidence that lynx are selecting habitat primarily on the abundance of primary prey (Hoving 2001).

3.2.4.1 Diet

Snowshoe hares are the primary prey to lynx, comprising 35 to 97 percent of the diet throughout the range of the lynx (Koehler and Aubry 1994). Other prey species include red squirrel, several species of grouse (*Bonasa umbellus*, *Dendragopus obscurus, Canachites canadensis*, *Lagopus* spp.), flying squirrel (*Glaucomys sabrinus*), ground squirrel (*Spermophilus parryii*, *Spermophilus richardsonii*), porcupine (*Erethrizon dorsatum*), beaver (*Castor canadensis*), mice (*Peromyscus* spp.), voles (*Microtus* spp.), shrews (*Sorex* spp.), fish, and ungulates as carrion or occasionally as prey (Saunders 1963a; van Zyll de Jong 1966; Nellis et al. 1972; Brand et al. 1976; Brand and Keith 1979; Koehler 1990; Staples 1995; O'Donoghue et al. 1998b).

The importance of other prey species, especially red squirrel, increases in the diet during periods when snowshoe hares become scarce (Brand et al. 1976; O'Donoghue et al. 1998b; Apps 2000; Mowat et al. 2000). However, Koehler (1990) suggested that a diet of red squirrels alone might not be adequate to ensure lynx reproduction and survival of kittens.

Most research has focused on the winter diet. Summer diets are poorly understood throughout the range of lynx. Mowat et al. (2000) reported that summer diets consist of less snowshoe hare and more alternate prey species than winter diets.

There has been limited research on the lynx diet in the southern portions of its range. Southern populations may prey on a wider diversity of species than northern populations because of lower snowshoe hare densities and differences in small mammal communities. In areas characterized by patchy distribution of lynx habitat, lynx may prey opportunistically on other species that occur in adjacent habitats, including white-tailed jackrabbit (*Lepus townsendii*), black-tailed jackrabbit (*Lepus californicus*), sage-grouse (*Centrocercus urophasianus*), and Columbian sharp-tailed grouse (*Tympanichus phasianellus*; Quinn and Parker 1987, Lewis and Wenger 1998).

3.2.4.2 Den Site Selection

Lynx den sites are found where coarse woody debris, such as downed logs and windfalls, provides denning sites with security and thermal cover for lynx kittens (McCord and Cardoza 1982, Koehler 1990, Koehler and Brittell 1990, Slough 1999, Squires and Laurion 2000). The integral component for all lynx den sites appears to be the amount of downed, woody debris present rather than the age of the forest stand (Mowat et al. 2000). In Washington, lynx denned in lodgepole pine *(Pinus contorta),* spruce *(Picea* spp.), and subalpine fir *(Abies lasiocarpa)* forests older than 200 years with an abundance of downed woody debris (Koehler 1990). A den site in Wyoming was located in a mature subalpine fir/lodgepole pine forest with abundant downed logs and dense understory (Squires and Laurion 2000).

3.2.5 Range of Lynx within the Contiguous United States

Within the contiguous United States, the lynx's range coincides with that of the southern margins of the boreal forest along the Appalachian Mountains in the Northeast, the western Great Lakes, and the Rocky Mountains and Cascade Mountains in the West (Figure 3). In these areas, the boreal forest is at its southern limits, becoming naturally fragmented into patches of varying size as it transitions into subalpine forest in the West and deciduous temperate forest in the East (Agee 2000). Because the boreal forest transitions into other forest types to the south, scientists have difficulty mapping its exact boundaries (Elliot-Fisk 1988). Precisely identifying and describing the distribution of lynx habitat also is difficult because there are several vegetation and landform classifications and descriptions that have been published for various parts of North America (U.S. Forest Service and Bureau of Land Management 1999). However, the term ''boreal forest'' broadly encompasses most of the vegetative descriptions of this transitional forest type that makes up lynx habitat in the contiguous U.S. (Agee 2000).

In addition to appropriate vegetation type, delineation of the range of the lynx within the contiguous United States must consider snow conditions. Lynx are at a competitive advantage over other carnivores (e.g., bobcats or coyote) in areas that have cold winters with deep snow because of their morphological adaptations for hunting and surviving in such environments. Therefore, lynx populations may not be able to successfully compete and persist in areas with insufficient snow even if suitable forest conditions otherwise appear to be present (Ruediger et al. 2000; Ruggiero et al. 2000b; Hoving 2001). A consistent winter presence of bobcats indicates an area that is not of high quality for lynx.

Lynx in the contiguous United States are part of a larger metapopulation whose center is located in the northern boreal forest of central Canada; lynx populations emanate from this area (Buskirk et al. 2000; McKelvey 2000a, b). When there is a high in the lynx population in central Canada, it acts like a wave radiating out to the margins of the lynx range. The magnitude of the lynx population high emanating from the central Canadian boreal forest varies for each cycle (McKelvey et al. 2000a, b). This wave can be produced by local populations reacting to environmental conditions, dispersers, or a combination of these (McKelvey et al. 2000a). Schwartz et al. (2002) concluded this wave is driven by dispersers, based on findings of a high level of gene flow between lynx in Alaska, Canada, and the western United States.

An example of the cyclic population ''wave'' occurred in the 1960s and 1970s, when numerous lynx were reported in the contiguous United States far from source populations. These records of dispersing lynx correlate to unprecedented cyclic lynx highs in Canada (Adams 1963; Harger 1965; Mech 1973; Gunderson 1978; Thiel 1987; McKelvey et al. 2000a; Mowat et al. 2000). These dispersers frequently were documented in areas, such as Wisconsin, that are close to source populations of lynx in Canada or possibly northeastern Minnesota and that contain some boreal forest. But there also have been a number of occurrences of dispersers in unsuitable habitats far from source populations, such as North Dakota prairie (Adams 1963; Gunderson 1978; Thiel 1987; McKelvey et al. 2000a).

Lynx populations in the northeastern United States and southeastern Canada are separated from those in northcentral Canada by the St. Lawrence River. There is little evidence of regular hare or lynx population cycles in this area (Hoving 2001), but wide fluctuations in lynx and snowshoe hare populations do occur. On a smaller scale, fluctuating populations in the core of this area (Quebec's Gaspé Peninsula, western New Brunswick, and northern Maine) can potentially influence lynx distribution up to several hundred miles distant.

Lynx dispersing during periods of population highs will occupy many patches of boreal habitat at the periphery of their range. Some patches will be suitable to maintain a long-term population and some will not. Where the boreal forest habitat patches within the contiguous United States are large, with suitable habitat, prey, and snow conditions, resident populations of lynx are able to survive throughout the low period of the approximately 10-year cycle. Most likely the influx of lynx from populations in Canada at the high point of the cycle augments these resident populations. It is likely that some of these habitat patches within the contiguous United States are able to act as sources of lynx (where recruitment is greater than mortality) that are able to disperse and potentially colonize other patches (McKelvey et al. 2000b).

In other areas, the lynx that remain in an area after a cyclic population high may be so few or in naturally marginal habitat that they are not able to persist or establish local populations, although some reproduction may occur. Such areas naturally act as population sinks (McKelvey et al. 2000b). Sink habitats are most likely those places on the periphery of the southern boreal forest where habitat naturally becomes patchier and more distant from larger lynx populations. Lynx found in these sink habitats are considered dispersers, but are usually included within the species range. Changes in the habitat conditions or cyclic fluctuations in the prey populations may cause some habitat patches to change from being sinks to sources and vice versa. Through this natural process, local lynx populations in the contiguous United States may ''blink'' in and out as the metapopulation goes through the 10-year cycle. Where habitat is of high enough quality and quantity, resident lynx populations are able to become established or existing populations are augmented, aiding in their long-term persistence.

Some maps (e.g., Hall and Kelson 1959) incorrectly portray the range of the lynx by encompassing peripheral records from areas that are not within boreal forest or do not have cold winters with deep snow, such as prairie or deciduous forest. Such maps have led to a misperception that the historic range of the lynx in the contiguous United States was once much more extensive than ecologically possible. Records of lynx outside of southern boreal forest in peripheral habitats that are unable to support lynx represent long-distance dispersers that are lost from the metapopulation unless they return to boreal forest and contribute to the persistence of a population. These unpredictable and temporary occurrences are not included within either the historic or current range of lynx because they are well outside of lynx habitat. This includes records from Connecticut, Indiana, Iowa, Massachusetts, Nebraska, Nevada, North Dakota, Ohio, Pennsylvania, South Dakota, and Virginia (Hall and Kelson 1959; Burt 1954 *as cited in* Brocke 1982; Gunderson 1978; McKelvey et al. 2000a). States that support some boreal forest and have frequent records of lynx are assumed to be the historic and current species range; these states include Colorado, Idaho, Maine, Michigan, Minnesota, Montana, New Hampshire, New York, Oregon, Utah, Vermont, Washington, Wisconsin, and Wyoming.

3.2.5.1 Lynx Distribution within Great Lakes Region

The majority of lynx occurrence records in the Great Lakes Region are associated with the mixed deciduous-coniferous forest type (McKelvey et al. 2000a). Within this general forest type, the highest frequency of lynx occurrences have been in white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), jack pine (*Pinus banksiana*), white pine (*P. strobus*), red pine (*P. resinosa*), black spruce (*Picea mariana*), and mixed black spruce and tamarack (*Larix laricina*) forest types. These forest types are found primarily in northern Minnesota, northern Wisconsin, and Michigan's Upper Peninsula.

Although the mixed deciduous-coniferous forest covers an extensive area in the Great Lakes Region, much of this area may be marginal habitat for lynx because it is a transitional forest type at the edge of the snowshoe hare range. Habitat at the edge of hare range supports lower hare densities (Buehler and Keith 1982) that may not be sufficient to support lynx reproduction. Furthermore, appropriate habitat with snow depths that allow lynx a competitive advantage over other carnivores (e.g., coyotes) occur only in limited areas in northeastern Minnesota, extreme northern Wisconsin, and Michigan's Upper Peninsula.

The historic status of lynx in the Great Lakes Region is uncertain. Minnesota has a substantial number of lynx reports (McKelvey et al. 2000a), which is expected because of the connectivity of the boreal forest with that of Ontario, Canada, where lynx occur. Wisconsin and Michigan have substantially fewer records of lynx (McKelvey et al. 2000a). Researchers have debated whether lynx in this region are simply dispersing individuals emigrating from Canada, are members of a resident population, or are a combination of a resident population and dispersing individuals (Sando 1998; McKelvey et al. 2000a). Recent research efforts in Minnesota have confirmed a resident population of lynx. Reproduction has been documented in all years since 2001. However, there are a few records of lynx occurrence in Michigan and Wisconsin during this same period.

3.3 Baseline Environment of the Great Lakes Geographic Area

Lynx are found within several geographic areas within the United States: the Cascade Mountains Geographic Area, Northern Rocky Mountains Geographic Area, Southern Rocky Mountains Geographic Area, Great Lakes Geographic Area, and Northeast Geographic Area. These geographic areas are separated from each other by expanses of unsuitable habitats that limit or preclude lynx movement, except the Northern Rockies and Cascades (Federal Register 2000).

Canada lynx in northern Minnesota are found within the Great Lakes Geographic Area. The Great Lakes Geographic Area encompasses northeastern and north-central Minnesota, northern Wisconsin, and the Upper Peninsula and northern portions of Michigan. The majority of lynx occurrence records in the Great Lakes Geographic Area are associated with the mixed deciduous-coniferous habitat type (McKelvey et al. 2000a). About 4.5 million of the 6 million acres (1.8 million of the 2.4 million ha) of Forest Service-administered lands in the Great Lakes Geographic Area are mapped as primary lynx habitat. These lands comprise about 19 percent of all lynx habitat within the Great Lakes Geographic Area. About 2 million acres are included within nondevelopmental land allocations where natural processes are expected to predominate. Private lands account for about 81 percent of the lynx habitat within the Great Lakes Geographic Area.

3.4 Status of Canada Lynx within the Great Lakes Geographic Area

The proposed project area is within the Great Lakes Geographic Area and is within the species range. Approximately 317 mi^2 (822 km^2) in northern Minnesota (Voyageurs National Park) has been designated as critical habitat and is within this Geographic Area (Federal Register 2006). Voyageurs National Park is approximately 75 miles (120 km) from the proposed mine project site. For the purposes of this assessment, the study area includes those areas within 6 miles (10 km) of proposed mine project disturbance (Figure 4), or approximately 250 mi^2 (648 km^2). This area was identified by the USFWS as the minimum area that needed to be surveyed to identify lynx that could be impacted by the proposed project. The USFWS felt that lynx having territories further than 6 miles (10 km) from the mine project would likely not be affected by the project.

3.4.1 Historical Records of Lynx in Northern Minnesota

The proposed project is near Nashwauk, in Itasca County, Minnesota. The majority of lynx occurrence records are from the northeastern portion of Minnesota; however, dispersing lynx have been found throughout Minnesota outside of typical lynx habitat (Gunderson 1978; Mech 1980; McKelvey et al. 2000a). In northeastern Minnesota, where deep snow accumulates, suitable lynx and snowshoe hare habitat is present. Much of this area is protected as designated wilderness, including the Boundary Waters Canoe Area. Furthermore, these habitats are contiguous with the boreal forest in southern Ontario. Until 1965, lynx had a bounty placed on them in Minnesota. In 1976, the lynx was classified as a game species, and harvest seasons were established (DonCarlos 1994). Harvest and bounty records for Minnesota are available since 1930. Approximate 10-year cycles are apparent in the data, with highs in the lynx cycle in 1940, 1952, 1962, and 1973 (Henderson 1978; McKelvey et al. 2000a). During a 47-year period (1930–1976), the Minnesota lynx harvest was substantial, up to 400 lynx in a year (Henderson 1978). These harvest returns for Minnesota are believed to be influenced by influxes of lynx from Canada, particularly in the 1960s and 1970s (Henderson 1978; Mech 1980; DonCarlos 1994; McKelvey et al. 2000a). When an anticipated lynx cyclic high for the early 1980s did not occur, the harvest season was closed in 1984 (DonCarlos 1994) and remains closed today.

Reproduction and maintenance of home ranges by lynx in Minnesota was documented in the early 1970s (Mech 1973, 1980), which may be evidence of a resident population. The early 1970s were a period when the second highest lynx harvest returns in the 20th century occurred throughout Canada. The high numbers of lynx trapped in Minnesota during this period likely included immigrants from Canada (McKelvey et al. 2000b). Lynx were consistently trapped over 40 years during cyclic lows, which may indicate that a small resident population occurred historically.

3.4.2 Observations of Lynx in the Vicinity of the Study Area Since 2000

Observations of lynx based on trapping records and visual observations show that lynx are more likely to be found in northeastern Minnesota than in the study area. Based on sightings of lynx since 2000, the proposed mine project site is on the western edge of the core area used by lynx in Minnesota (Figure 5). A total of 16 (1 confirmed, 15 probable or unconfirmed) sightings of lynx have been recorded in Itasca County since 2000. One confirmed sighting of a lynx was made in the northern portion of the county, approximately 20 miles (32 km) from the project site (Figure 6). Several sightings have been within or near the study area. Few, if any, observations are the result of a systematic effort to find lynx in Minnesota. The vast majority are incidental encounters, and as such, tend to be clustered along roads and other places frequented by observant and interested people. Thus, while these reports tell us something (however incomplete) about where lynx are, they provide no information about where lynx do not occur. Similarly, the relationship between the number of reports and the number of lynx in Minnesota at the time of the reports is unknown (MNDNR 2007).

The majority of confirmed and unconfirmed sightings in Minnesota have been made in the three counties to the east of Itasca County: Lake, Cook, and St. Louis counties. Of the 435 sightings reported to the Minnesota Natural Heritage and Nongame Research Program since 2000, 75 percent have been in these three counties; only 4 percent of sightings have been in Itasca County. Approximately 113 lynx have been sighted in St. Louis County, which is immediately east of Itasca County, since 2000, and 14 of these lynx had young (MNDNR 2007).

3.4.3 Habitat Characteristics

Minnesota Steel estimated cover types for lands that could be impacted by the project using Geographic Information System (GIS) data files maintained by the MNDNR. Acreages are approximate and are based on 1986 Mesabi Range Project Maps, updated with aerial photographs (MNDNR 2005a). These data were used to determine habitat availability within the proposed project area. Based on cover types developed for the study, wooded/forest habitats would provide the majority of habitat for lynx. The remaining cover types include wetlands, brush/grassland, and disturbed area.

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Approximately 3,139 acres (1270 ha) are associated with areas that would be disturbed by non-tailings-related mine operations (Figure 7). This includes 536 acres (217 ha) of infrastructure-connected actions (sewer, water, natural gas, railroads, transmission lines). Wooded/forested areas that could be used by lynx comprise 37 percent (1,169 acres [473 ha]) of the lands. Most of this habitat consists of deciduous and mixed (coniferous and deciduous) pole and young mature forest (consisting of trees generally less than 10 inches (25 cm) diameter at breast height). The remaining habitat consists of wetlands (468 acres; 189 ha) and brush/grassland (746 acres; 302 ha), as well as minor amounts of agricultural lands, and residential and commercial development

If the Stage I Tailings Basin is used, approximately 1,580 acres (639 ha) would be disturbed for the tailings facility. Of these acres, wooded/forested areas that could be used by lynx comprise 21 percent (333 acres [135 ha]) of the lands. Most of this habitat consists of deciduous and mixed pole and young mature forest. The remaining habitat consists of wetlands (154 acres; 181 ha) and brush/grassland (738 acres; 299 ha).

If the Alternative Tailings Basin was used, approximately 1,119 acres (453 ha) would be disturbed; none of these acres have been disturbed by previous mining activity. Wooded/forest habitat comprises 64 percent

(717 acres; 290 ha) of this land. The remaining habitat consists of wetlands (239 acres; 97 ha) and brush/grassland (163 acres; 66 ha).

3.4.4 Previous Field Studies

A 2-day survey for lynx and their habitats was conducted in the proposed project area during late March and early April 2006. No lynx or their sign were identified during this survey. Snowfall was limited to scattered patches, making lynx sign identification and tracking difficult.

Waste rock piles and the mine pit had sparse timber and little habitat for lynx. However, grouse and snowshoe hare sign were seen within the survey area, suggesting that lynx could use the survey area. Conifer distribution increased as one moved to the north and east, providing more suitable habitat for snowshoe hare and lynx. As one moved to the west and south, conifers were less abundant and more widely distributed. However, young conifers were found in the southwest portion of the mine project area and could provide habitat for snowshoe hare in about 10 years. Much of the survey area had been logged, but areas with good stands of balsam fir could provide habitat for lynx.

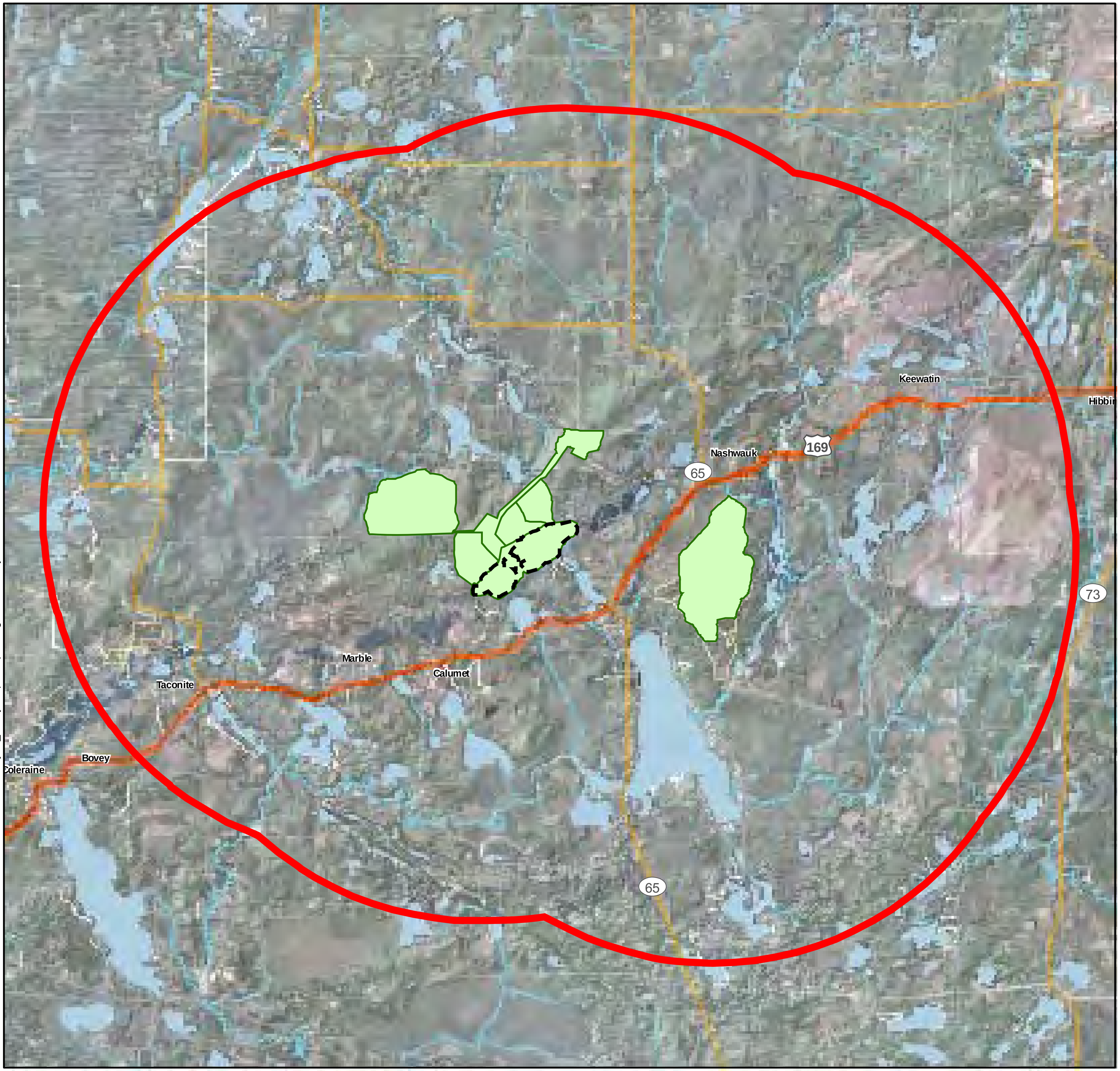
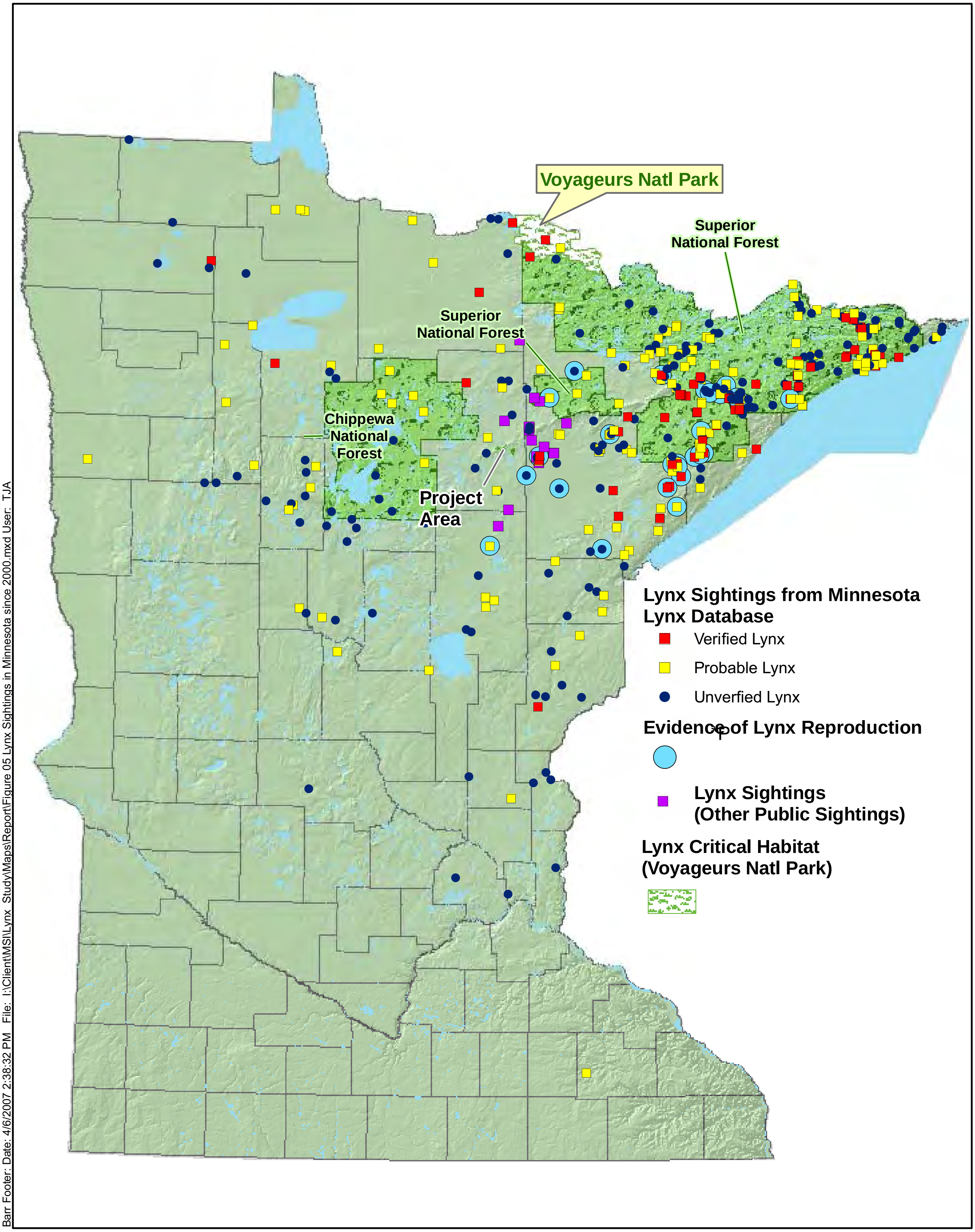


Figure 4
STUDY AREA
Minnesota Steel Industries

Barr Footer: Date: 4/12/2007 4:44:58 PM File: I:\Client\MSI\Lynx_Study\Maps\Report\Figure 04 Study Area.mxd User: TJA



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Miles

Figure 5

LYNX SIGHTINGS IN MINNESOTA SINCE 2000

Minnesota Steel Industries

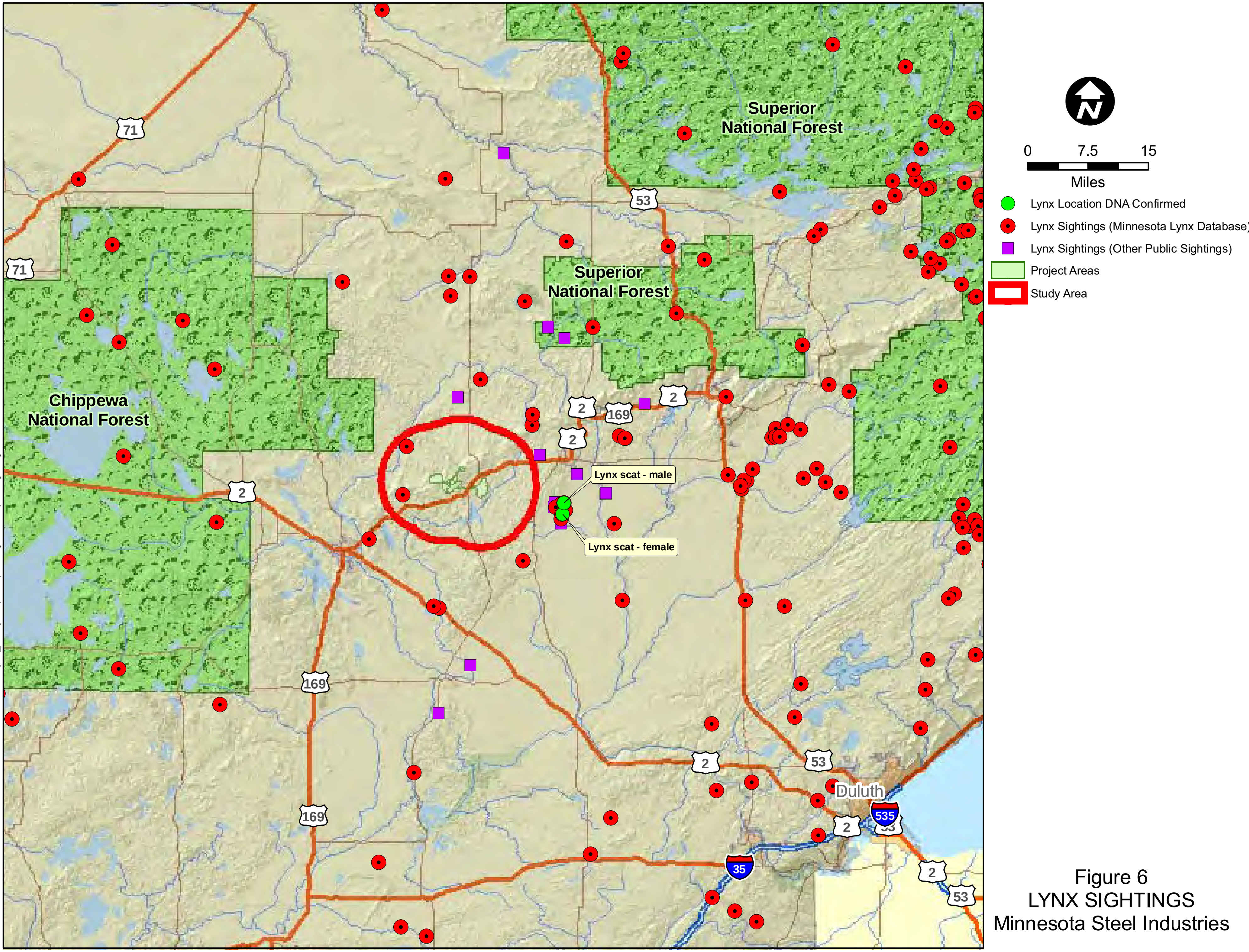
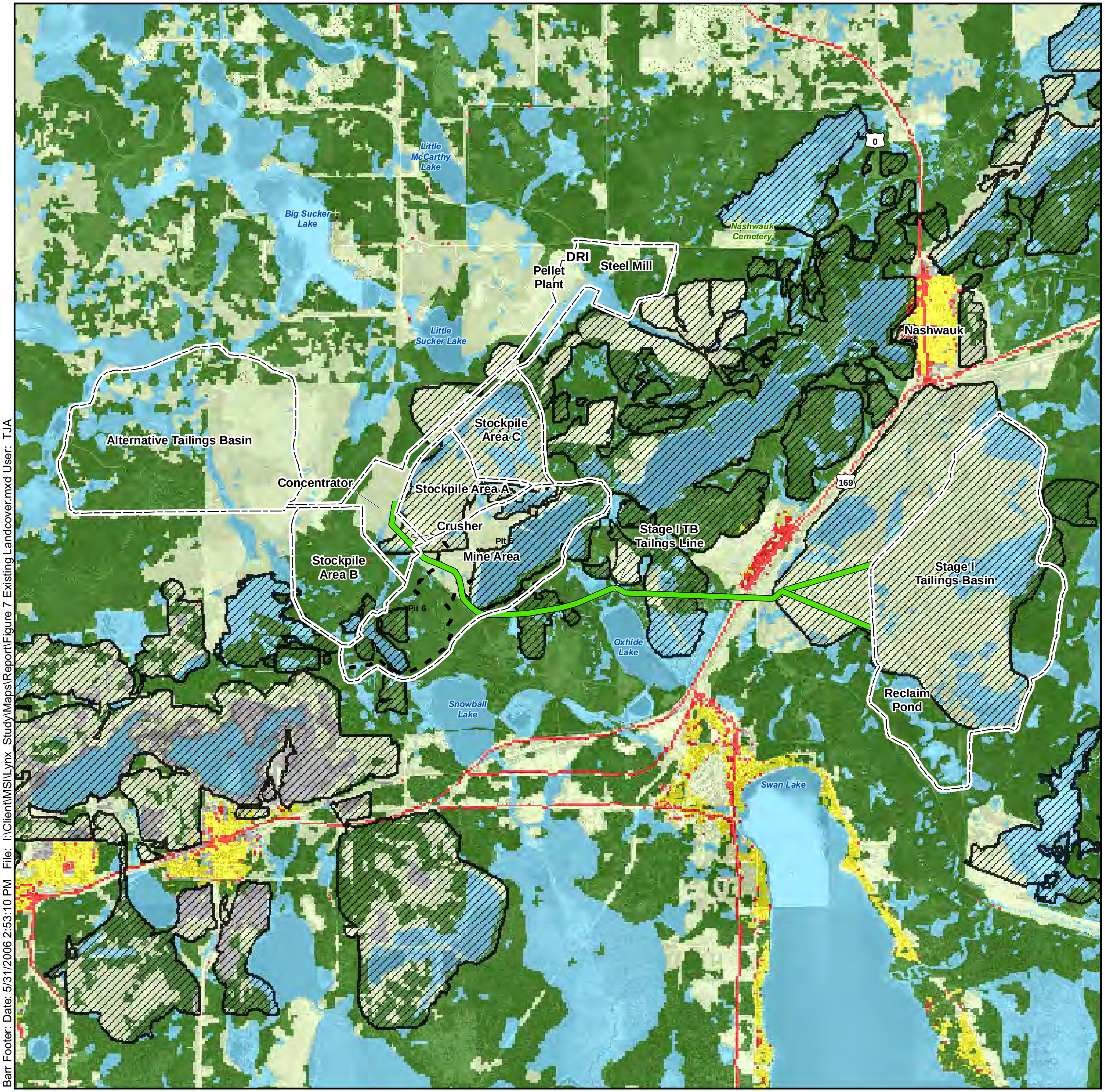


Figure 6
LYNX SIGHTINGS
Minnesota Steel Industries



Miles
0 0.5 1

Project Areas
Stage 1 TB Tailings Line
Areas Disturbed by Previous Mining Activities*

Landcover**

Commercial/Industrial/Transportation
Residential
Disturbed land
Crop Land
Brush/Grassland
Wooded/Forest
Types 1 to 8 Wetlands (includes lakes)

* Edited From DNR 2003 Mine Features Mapping

**Land Cover Data Sources:
MSI Wetland Mapping
2000 Plant Communitites Mapping
USGS 1992 NLCD
DNR GAP Land Cover
DNR 2003 CIR Photography
IRRRB Mapping

Figure 7
LAND COVER
Minnesota Steel Industries

Barr Footer: Date: 5/31/2006 2:53:10 PM File: I:\Client\MSI\Lynx Study\Maps\Report\Figure 7 Existing Landcover.mxd User: TJA

4.0 STUDY AREA AND METHODS

4.1 Study Area

The primary study area for lynx was determined based on discussions with the USFWS (Burke 2006). The primary study area extended out approximately 6 miles (10 km) from the proposed disturbance area (Figure 4). This area encompasses much of the home range of lynx that might have occurred near the mine project site. Within this area, surveys were primarily conducted in the following seven townships: Township 56 North, Ranges 21, 22, 23 and 24 West; and Township 57 North, Ranges 22, 23, and 24 West. This area is approximately 250 mi^2 (648 km^2). In addition, some time was spent conducting lynx surveys in other townships in or adjacent to the study area.

4.2 Methods

4.2.1 Literature Review and Personal Communications

We reviewed the *2006 Lynx Assessment Final Interim Report* (ENSR 2006) and the *2007 Lynx Assessment Survey Plan* (ENSR 2007). We conducted telephone and in-person interviews with agency staff of the MNDNR, USFWS, and public living in or near the study area to obtain information concerning lynx occurrence in the study area.

4.2.2 Database Queries

We queried the MNDNR lynx sightings database for sightings that have occurred in the vicinity of the study area since 2000 (http://www.dnr.state.mn.us/ecological_services/nhnrp/research/lynx_sightings.html). We reviewed the Natural Resources Research Institute (NRRI) lynx website (http://www.nrri.umn.edu/lynx/) for records of radio-marked lynx within the study area. We also reviewed the Superior National Forest's lynx genetic reference database for records of lynx occurrence within 20 miles (32 km) of the study area.

4.2.3 Field Surveys

Field surveys for lynx and other felids (bobcat and mountain lion) were conducted during January through March 2007.

4.2.3.1 Survey Objectives

The objectives of the field surveys were to:

- record lynx and other wild felid sign observed in the study area;
- for each lynx trail found, attempt to obtain and analyze a DNA sample from scat to identify the individual making the track and to establish a genetic reference collection of individual lynx in the area;
- attempt to collect and analyze three scat samples from bobcat trails occurring in the study area.
- estimate how many lynx are in the study area; and
- estimate the habitat use and range of lynx in the study area.

4.2.3.2 General Survey Methodology

Steve Loch, a biologist experienced in snow-tracking lynx, conducted field surveys when there was sufficient snow on the ground to locate felid trails. All seven townships in the study area were surveyed during the survey period. In addition, some time was spent conducting lynx surveys in other townships in or adjacent to the study area.

During the surveys, information on felids, their sign, and their habitat use in the study area was recorded. Felid sign included trails, tracks, scat, hair, resting beds, and foraging sign (e.g., prey kills; McKelvey et al. 2006). The locations of wild feline sign were recorded using a Garmin Map 76CSx Global Positioning System (GPS), and recorded on aerial photographs or topographic maps. A survey route log was made using GPS track logs. Time of day was recorded during surveys.

4.2.3.3 Snow Tracking Surveys

Surveys were conducted during daylight from a snowmobile or four-wheel drive vehicle. Transects were primarily located along county and township roads, highway rights-of-way, snowmobile trails, logging roads, skid trails, river and stream channels, power transmission line rights-of-way, abandoned railroad grades, and existing hand-cut ATV trails. In addition, transects in habitats favored by lynx were occasionally surveyed on foot.

The study area was divided into zones that were systematically searched for lynx and other felids. We attempted to survey a minimum of 50 miles (80 km) of trail per township. Surveys began at least 24 hours after a snowfall to provide a reasonable chance of detecting tracks. If high winds had obscured or obliterated snow trails, surveys began 24 hours after the winds had subsided. Surveys continued after a snowfall as long as snow conditions were suitable to accurately identify and follow felid tracks. We surveyed transects in protected forest habitats when we felt that wind might be affecting track condition or detection in open areas. To the extent possible, we avoided surveying transects when the surface of the snow pack appeared recently wind swept by vehicles or by wind channeling (e.g., along transmission line rights-of-way or roadways). We also attempted to avoid surveying roadway transects that had been plowed when it appeared we might not see all animal trails.

When surveying, we maintained visual contact along a continuous sight line to detect any animal that had walked to that line since the last significant snowfall. Survey vehicles were driven at a speed suitable for detecting lynx tracks. We surveyed at a much slower rate where there were animal tracks (e.g., snowshoe hare and deer) that might have interfered with detection of felid trails, and when there was less than an inch of fresh snow cover, as lynx trails are less conspicuous in this circumstance.

When we encountered an animal trail, we evaluated its possibility of being felid based on the appearance of the track and trail. Generally, lynx tracks are conspicuous and readily identifiable; however, since coyote, wolf, and domestic dogs (*Canis domesticus*) are present in the study area, we also evaluated snow tracks produced by these canids. We also examined trails of large fishers (*Martes pennanti*) when the track showed a walking gait.

When a felid trail was encountered, the felid track intercept was recorded using a GPS waypoint where the animal's trail intercepted the survey route. If a lynx traveled on a survey route for more than 164 feet (50 m), another waypoint was made where its trail diverged from the survey route.

4.2.4 DNA Analysis

When a felid scat was collected, we assigned it a reference label identifying the waypoint established at the collection site. Scat samples were placed in a paper bag at the collection site and later thawed and air dried at room temperature. Each sample was transferred to a vial containing 18-mesh silica desiccant to inhibit enzyme activity that degrades DNA. Samples were sent to the Forest Service Rocky Mountain Research Station Wildlife Ecology Unit laboratory in Missoula, Montana. In the laboratory, DNA was extracted from up to 220 milligrams of sample using the *QIAMP DNA Stool Minikit* (*QIAGEN Inc*., Germany). Each sample was then amplified at the 16S rRNA region of the mitochondrial genome and subjected to restriction enzyme assays to identify species (Mills et al. 2000).

The samples were then analyzed using microsatellite DNA to identify individuals. All samples were amplified at microsatellite markers *Lc106, Lc109, Lc110, Lc111, Lc118,* and *Lc120* and the resultant products visualized on a *LICOR* DNA analyzer.

All samples were run a minimum of three times to avoid genotyping error such as allelic dropout or false alleles. Genotypes were scored by two independent observers. If there were discrepancies in scoring, the samples were run an additional three times at the marker under question. DNA was re-extracted from samples that initially failed to amplify (showed poor quality DNA). Any samples that failed to amplify at four loci or displayed inconsistent scores at four of six loci were discarded.

The samples were further tested for lynx-bobcat hybridization (see Schwartz et al. 2004) and sex (see Pilgrim et al. 2005).

5.0 RESULTS

5.1 Past Observations of Lynx In or Near the Study Area

Lynx sightings made between 2000 and 2006 in the vicinity of the study area and in Minnesota are shown in Figures 5 and 6 (MNDNR 2007). The majority of confirmed and unconfirmed sightings in Minnesota have been made in the three counties to the east of Itasca County: Lake, Cook, and St. Louis counties. Of the 435 sightings reported to the Minnesota Natural Heritage and Nongame Research Program since 2000, 75 percent have been in these three counties. Approximately 113 lynx have been sighted in St. Louis County since 2000, and 14 of these lynx had evidence of reproductive activity.

A review of the NRRI website indicated that the radio locations of their study animals have not occurred in the study area. Generally, telemetry search flights for missing radio collared animals have not been conducted over the survey or west of U.S. Highway 53.

The Superior National Forest genetic reference collection shows that three unique lynx and a lynx-bobcat hybrid have been found within 18 miles (30 km) of the study area. All four records occurred prior to November 2005.

During March and November 2005, scat samples from a male and female lynx were collected in Township 56 North, Range 21 West (Loch 2007). Additionally, periodic sightings of lynx were made in the eastern half of this township from June 2004 through November 2005. Based on interviews with area residents, there is evidence of lynx reproduction in this area; there were sightings of litters of five kittens in 2004 and four kittens in 2005. However, no lynx were located in the township during the 2007 survey period and no sightings have been reported for the area since early winter 2005-06. Thus, we believe that lynx are no longer resident in this township.

5.2 2007 Field Surveys and DNA Analysis

5.2.1 Snow Tracking Survey

Snow tracking surveys were conducted on 41 days from January 4 to March 20, 2007. We surveyed transects on 39 days and snow-tracked bobcat on 9 days with both activities occurring on some days. The majority of field time was spent surveying for felids within the study area. We did not observe lynx, cougar, wolverine, or their sign in the study area.

Approximately 541 miles (870 km) of transect were surveyed in the study area, and 73 miles (117 km) were surveyed in townships adjacent the study area (Figures 8 through 16; Table 1). Approximately 16 miles (25 km) of transect were surveyed per day.

Bobcat track intercepts were recorded by noting the locations where a bobcat approached or crossed a transect, or when bobcat tracks were spotted while traveling within the study area. Intercepts were recorded at 56 locations in 5 survey townships and in 2 townships adjacent the study area (Township 55 North, Range 21 West; Township 56 North, Ranges 20, 21, and 22; and Township 57 North, Ranges 22, 23, and 24). To avoid misidentification with coyote, bobcat trail intercepts were recorded only when plantar toe and heel pad marks were clearly visible within the prints of a track. We did not attempt to identify trails of small bobcats that may have occurred within 650 feet (200 m) of human dwellings. To assess bobcat occurrence for the possibility of lynx-bobcat hybridization, trails of animals presenting large tracks were followed and four scats were collected. The individual felids depositing these scats were identified by DNA analysis (see Section 5.3 below; Table 2).

Table 1. Miles Surveyed for Lynx in Each Township.

Townships in Study Area		Townships Outside of Study Area	
Township Surveyed	**Miles Surveyed in Township**	**Township Surveyed**	**Miles Surveyed in Township**
Township 56 North, Range 21 West	105.9	Township 55 North, Range 20 West	6.4
Township 56 North, Range 22 West	74.2	Township 55 North, Range 21 West	17.0
Township 56 North, Range 23 West	86.3	Township 56 North, Range 20 West	11.2
Township 56 North, Range 24 West	69.8	Township 58 North, Range 22 West	14.5
Township 57 North, Range 22 West	52.3	Township 58 North, Range 23 West	8.3
Township 57 North, Range 23 West	77.9	Township 58 North, Range 24 West	7.9
Township 57 North, Range 24 West	74.1	Other townships*	3.4

* Other townships include Township 55 North, Ranges 22, 23, and 24 West; Townships 56 and 57 North, Range 25 West; and Township 58 North, Range 21 West.

5.2.2 DNA Analysis

We submitted four scat for DNA analysis to determine species, sex, and identity (Table 2). All scats were collected within the study area. Based on DNA analysis of these samples, four unique bobcats were identified: one within Township 56 North, Range 22 West; two within Township 57 North, Range 24 West; and one in Township 56 North, Range 21 West. We determined that none of the four individuals was an F1 lynx-bobcat hybrid (Schwartz et al. 2004).

Table 2. Bobcat Identified by DNA Analysis of Scat.

Individual	Collection Date	Species	Sex	Sample	Section and Township
Bobcat 1	January 14	Bobcat	Male	Loch-S-48/MS	Section 22, Township 56 North, Range 22 West
Bobcat 2	February 2	Bobcat	Female	Loch-S-49/MS	Section 6, Township 57 North, Range 24 West
Bobcat 3	February 6	Bobcat	Female	Loch-S-50/MS	Section 36, Township 57 North, Range 24 West
Bobcat 4	March 20	Bobcat	Male	Loch-S-51/MS	Section 24, Township 56 North, Range 21 West

5.2.3 Lynx Sightings and Density in the Study Area

We believe that no lynx were residing within the study area, or in portions of townships surveyed adjacent to the study area, during the survey period.

It is possible that we did not detect lynx from outside the study area that periodically use the study area, or lynx that may have occurred on acreage in the eastern half of Townships 56 and 57 North, Range 22 West, or in the northwestern quarter of Township 56 North, Range 21 West, since those areas were not fully surveyed.

Only recently has the lynx population in Minnesota shown signs of recovering from an extended period of low numbers. Snowshoe hare population levels in Minnesota have declined since the 1980s. If snowshoe hare populations recover, the number of lynx in or near the study area might increase.

5.2.4 Lynx Habitat Use

Generally, lynx hunt within habitats where snowshoe hare are common or abundant. An essential aspect of lynx habitat is dense conifer or mixed-forest cover that provides security for snowshoe hares. Most hare kills occur in habitat where conifer saplings or young pole timber are prevalent and where significant acreage of this habitat type is available. Lynx also hunt hares in high stem density deciduous cover, such as alder (*Alnus* spp.) in riparian areas, and blue joint (*Calamagrostis canadensis*), willow (*Salix* spp.), and bog birch (*Betula pumila*) in creek bottoms or lowland areas.

Natural communities used most often by lynx are young jack pine/balsam fir forests. Balsam fir often occurs as inclusions or “pockets” of regenerating saplings within other cover types (e.g., in mature jack pine stands or in maturing spruce/aspen (*Populus tremuloides*) stands), and along forest edges. Lynx also use coniferous or mixed deciduous/coniferous forest patches in regenerating logged areas, including 10- to 25-year-old stands of jack pine or balsam fir/aspen mixed forest. Other important habitat types include spruce/balsam fir and black spruce/tamarack forests.

Currently, communities used by lynx in Minnesota often originate as a result of natural or “facilitated” regeneration after logging. However, fire and spruce budworm outbreaks also play a role in influencing forest stand composition and age in sites used by lynx.

Lynx use conifer plantations, especially where large stands of plantation forest occur in proximity to one another. Lynx use white spruce, jack pine, white pine, red pine, and mixed conifer plantations, particularly forests ranging from 10 to 30 years in age. Recent studies of snowshoe hare and red squirrel density suggest that hare and squirrel numbers are greatest in jack pine, red pine, black spruce, and mixed pole/young mature and mature forests; presumably lynx would be more common in these habitats (Moen et al. 2004). Lynx in Minnesota have been observed hunting snowshoe hare in dense stands of conifer saplings and in young and mid-sized pole forest, particularly balsam fir, spruce, and jack pine forests.

5.2.4.1 Habitat Suitability Within the Study Area

We observed habitat that was at least marginally suitable for lynx in all townships of the study area, except where lands had been disturbed by historic or ongoing mining operations, and where agricultural, community, or residential development had occurred. In some areas, suitable habitat existed adjacent to mine waste rock piles, tailings deposits, and active mine sites. Recent logging activity in Township 57 North, Ranges 22, 23, and 24 West, and Township 56 North, Range 22 West has reduced the acreage of suitable lynx habitat in those areas for the short term, but may enhance the suitability of these areas for lynx in the next decade if conifers regenerate.

Although lynx have been observed in the study area in the past, patches of suitable lynx habitat in most of the study area are separated from each other and not large enough to support lynx reproduction and use for extended periods of time. Only the eastern and southern portion of Township 56 North Range 21 West and in the area where the four corners of Townships 57 North, Range 23 and 24 West, and Townships 56 North, Ranges 23 and 24 West, meet appear to have enough suitable habitat to support lynx reproduction and use for longer periods of time.

In addition, habitat supporting highest snowshoe hare densities in the study area is not typical of that in northeastern Minnesota. In the study area, the best habitat for snowshoe hare is shrub swamp with timber interspersed within or on the periphery of the swamp. In northeastern Minnesota, however, regenerating dense conifer forests comprised of younger trees (e.g., balsam thickets where overhead canopy has been logged, damaged by significant disease, or otherwise opened up, or relatively young conifer plantations [15 to

40 years of age]) provide best habitat for hares and lynx. Shrub swamps are also important lynx and hare habitat, but they are less important than regenerating dense conifer forests.

Township 56 North, Range 21 West. The northwest portion of this township is not suitable for lynx due to active mining operations (tailings). Suitable lynx habitat exists in the southern and eastern portion of the township; this habitat is contiguous with suitable habitat in adjoining townships to the east and south. During the survey, no lynx were detected in this township, despite surveying 117 miles (188 km) of route within the township and at the western edge of an adjoining township (Township 56 North, Range 20 West). From November 2003 through approximately December 2005, observations of adult lynx, lynx kittens, and their sign were reported in this township. Lynx occurrence within this area is likely during the next decade if habitat remains relatively undisturbed.

Township 56 North, Range 22 West. Suitable habitat is generally limited to approximately the southeast quarter of the township. Lynx occurrence within this area is likely during the next decade if habitat remains relatively undisturbed.

Township 56 North, Range 23 West. Suitable habitat is generally present only in the northwestern quarter of the township, and possibly in the southeastern quarter. Recent logging in the northeastern quarter of the township has reduced the extent of suitable habitat in this area for the short term but forest regeneration could produce suitable habitat within the next 10 years. If existing conifer plantations in the northwestern quarter of the township produce dense horizontal cover, lynx use of this area is likely within the next decade. This habitat complex adjoins suitable habitats in Township 57 North, Ranges 24 and 23, and Township 56 North, Range 24

Township 56 North, Range 24 West. Habitat within this township has been affected by mining operations and, in general, most of the available habitat is marginal or unsuitable for lynx. Sections in northeast portion of the township offer the greatest potential for lynx use.

Township 57 North, Range 22 West. Recent logging in northern half of this township has reduced the acreage of suitable habitat for the short term, but forest regeneration is likely to produce patches of suitable habitat within the next 10 to 15 years. Mining activity in the east central portion of this township is extensive, making the area unsuitable for lynx. Suitability of habitat in the southern portion of township has been reduced due to historic mining operations. Lynx occurrence in the northern half of the township is likely in 10 to 15 years if suitable habitat remains, including on lands near or adjacent to active mine dumps.

Township 57 North, Range 23 West. Agricultural openings within this township tend to reduce the suitability of the habitat complex for lynx; much of the forested land currently lacks the potential for providing dense horizontal cover in the understory. Logging might eventually improve lynx habitat by inducing forest regeneration and promoting dense horizontal cover. Within the next 2 decades, periodic occurrence of lynx in certain habitats of this township is possible, especially in the southwest quarter of the township where the potential for lynx occurrence is greatest.

Township 57 North, Range 24 West. Recent logging, particularly in the northwestern quarter of this township, has reduced the acreage of suitable lynx habitat for the short term, but forest regeneration could produce patches of higher quality habitat within the next decade. Occurrence of lynx in suitable habitat of this township is likely within the next 10 years, especially in the southeastern quarter.

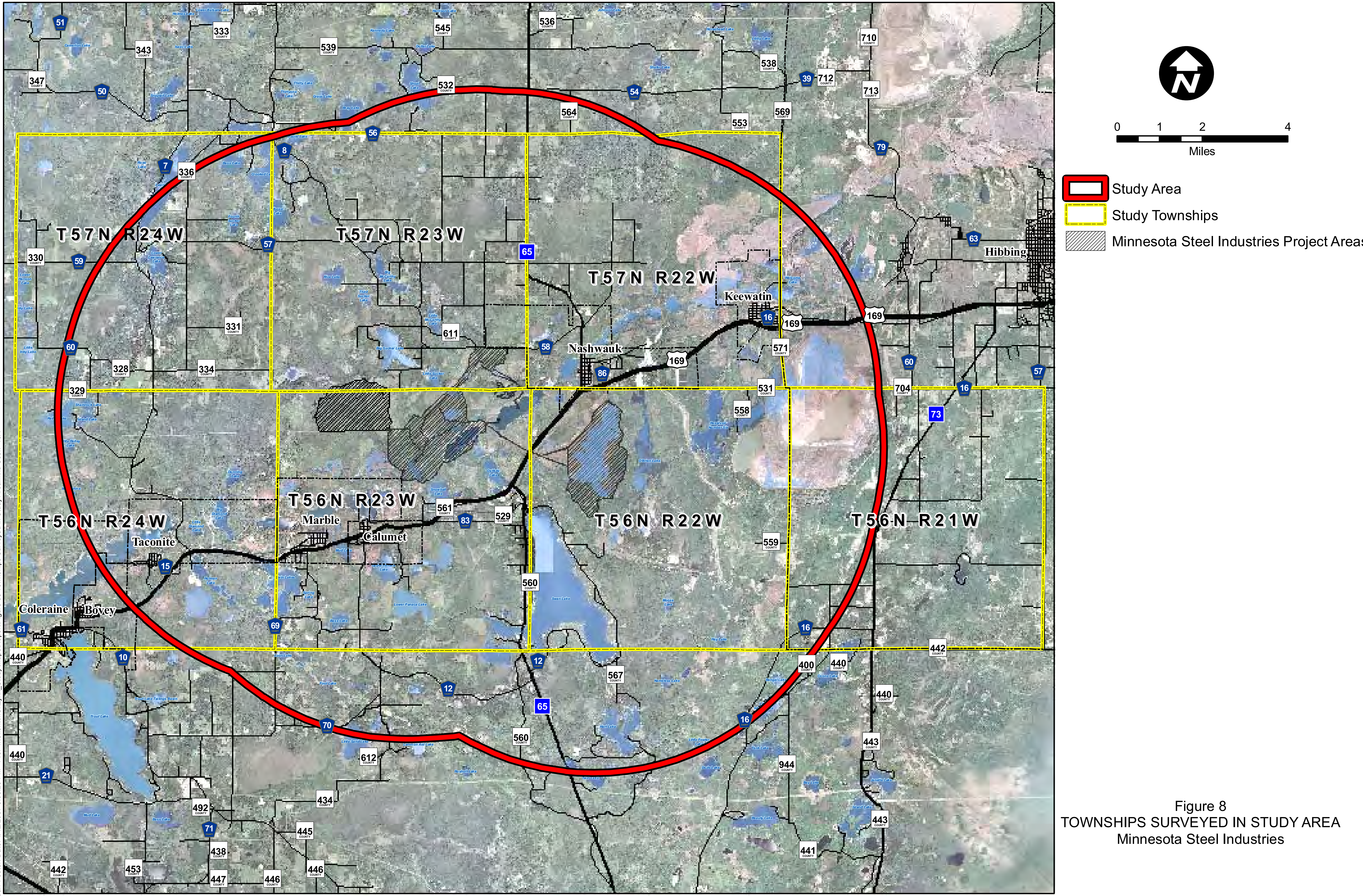


Figure 8
TOWNSHIPS SURVEYED IN STUDY AREA
Minnesota Steel Industries

Barr Footer: Date: 4/12/2007 5:00:25 PM File: I:\Client\MSI\Lynx_Study\Maps\Report\Figure 08 Townships Surveyed in Study Area.mxd User: TJA

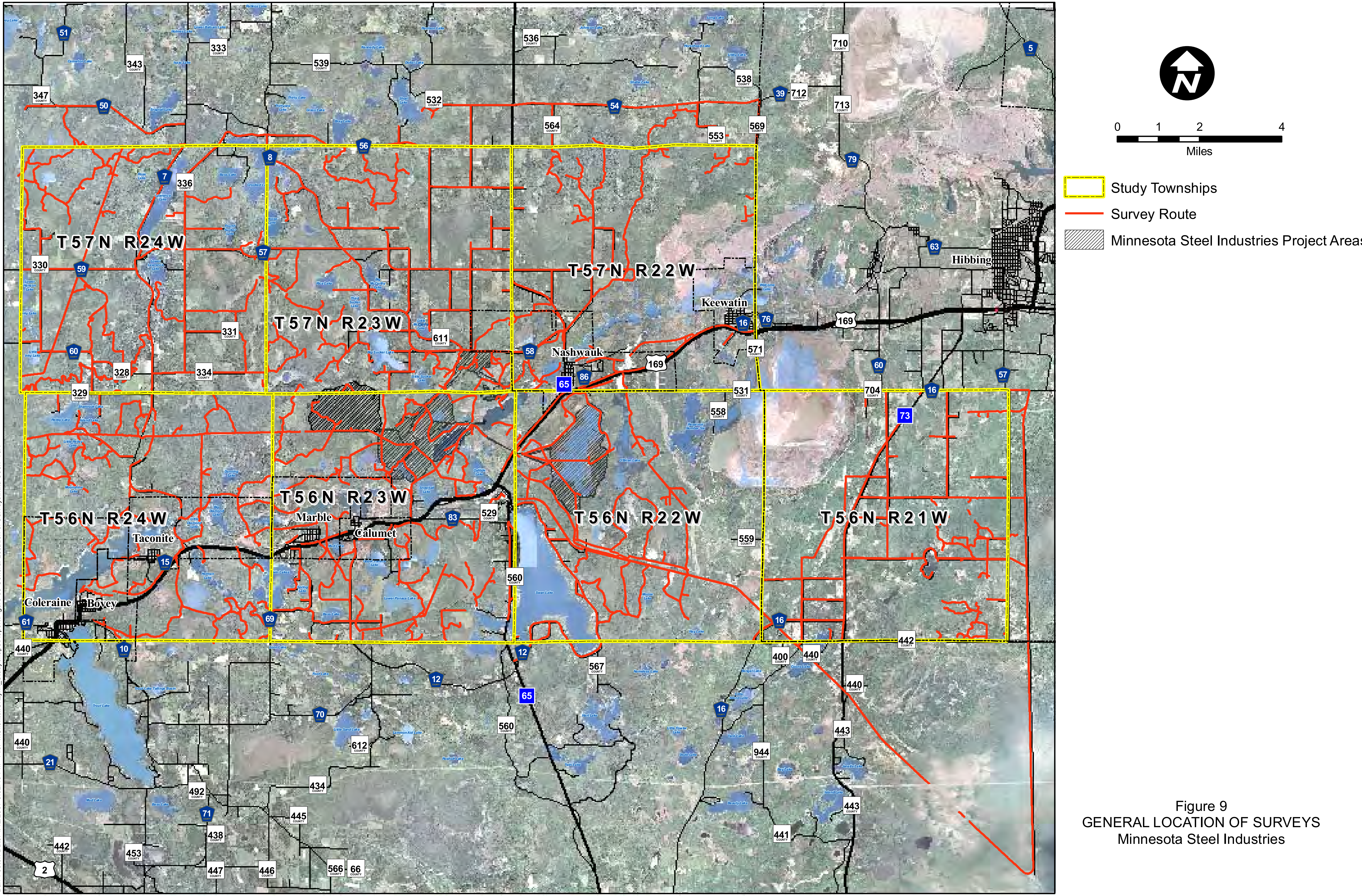
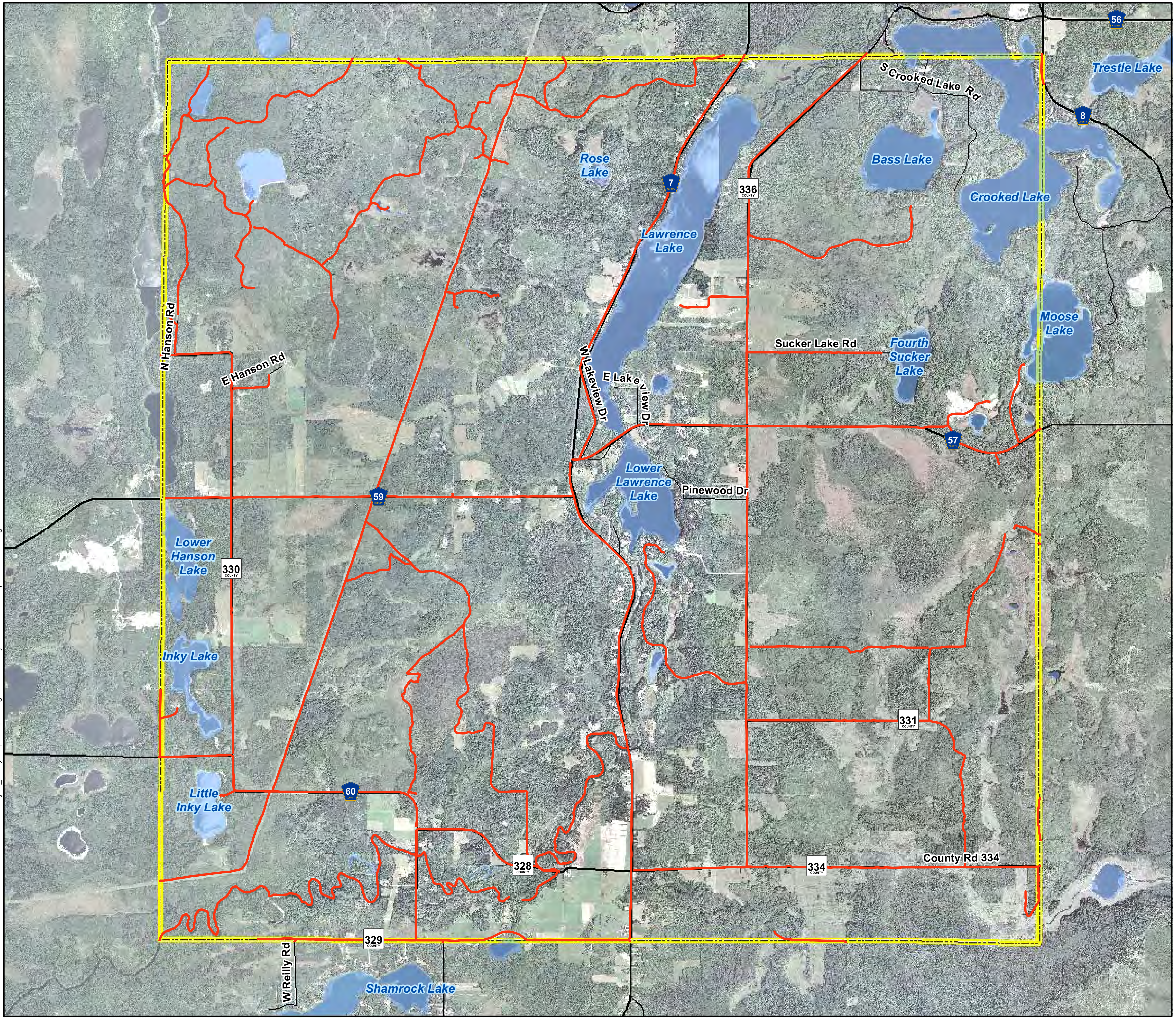


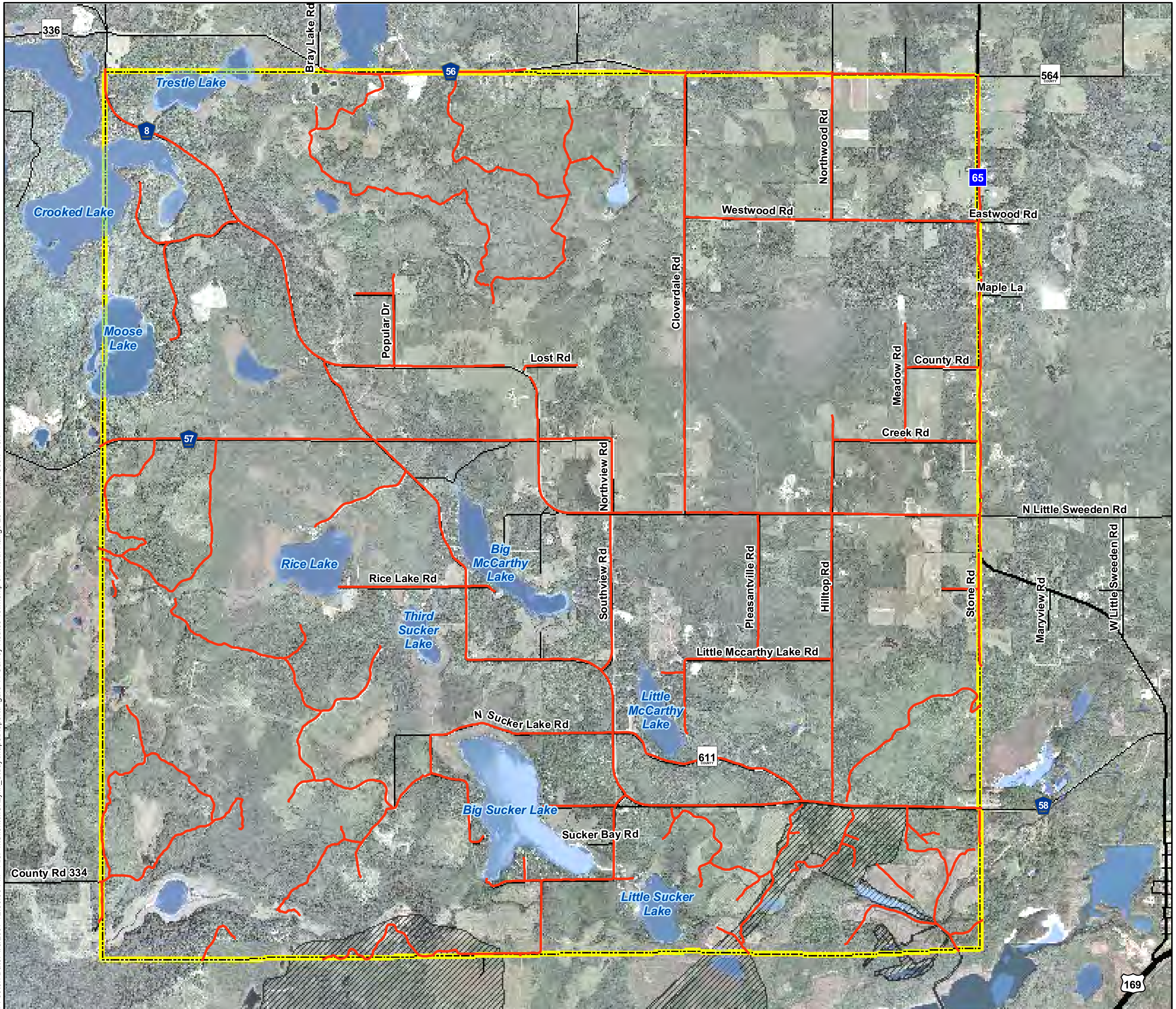
Figure 9
GENERAL LOCATION OF SURVEYS
Minnesota Steel Industries



Note:
No lynx trails or sign found in this township.

Barr Footer: Date: 4/6/2007 12:34:22 PM File: I:\Client\MSI\Lynx_Study\Maps\Report\Figure 10 Survey Routes Township 57 North Range 24 West.mxd User: TJA

Figure 10
SURVEY ROUTES
TOWNSHIP 57 NORTH RANGE 24 WEST
Minnesota Steel Industries

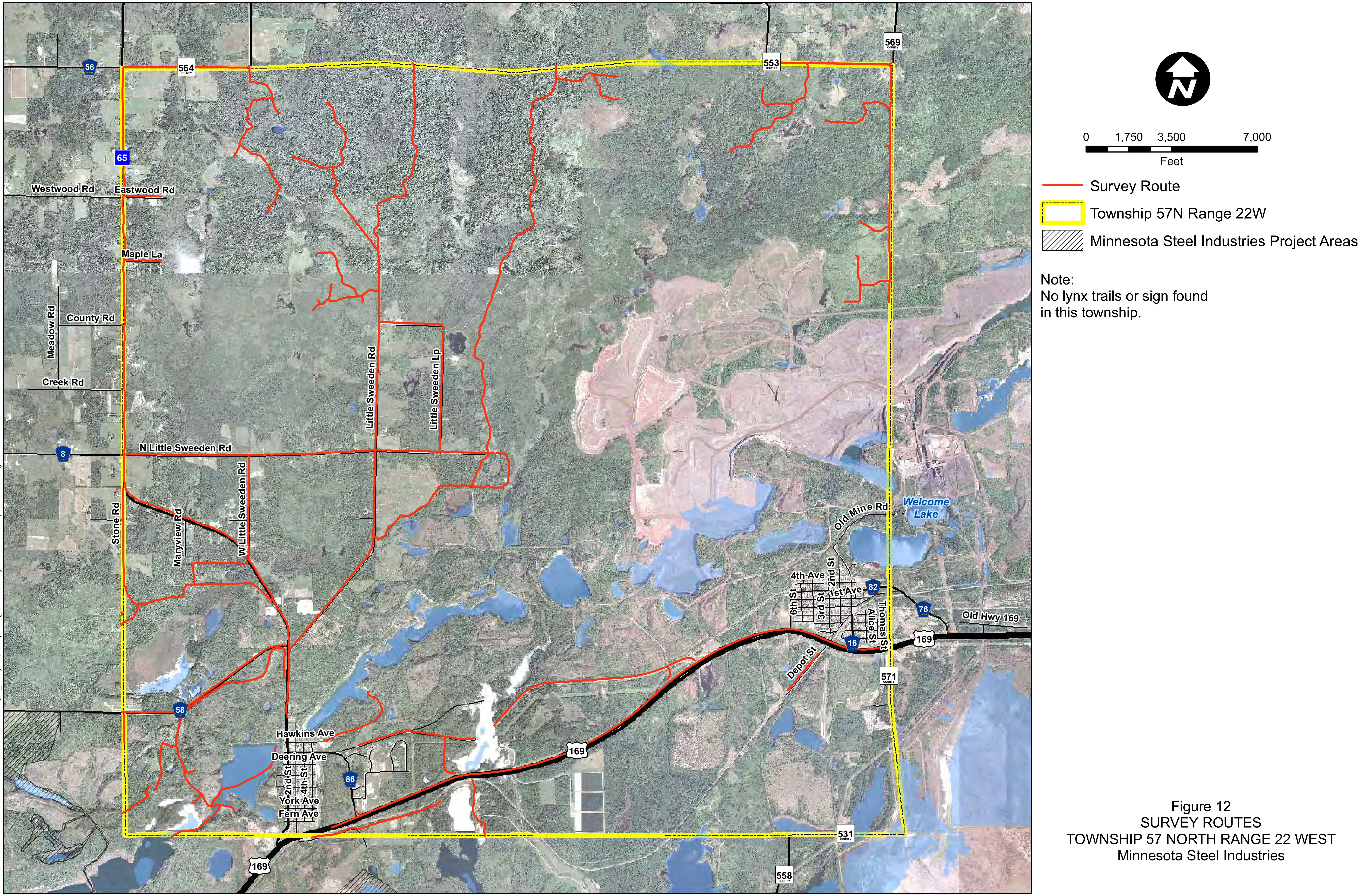


0 1,750 3,500 7,000
Feet

Survey Route
Township 57N Range 23W
Minnesota Steel Industries Project Areas

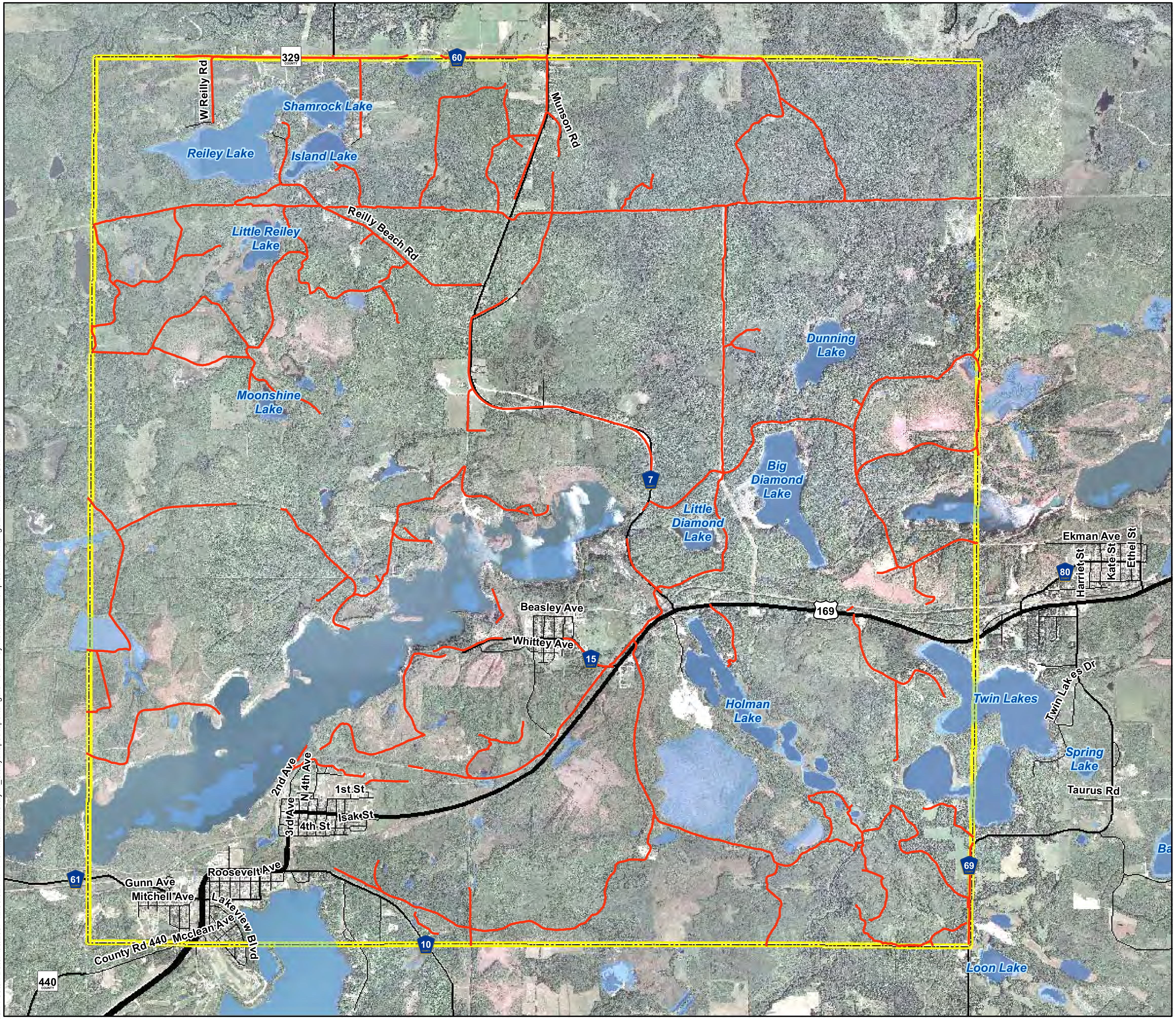
Note:
No lynx trails or sign found in this township.

Figure 11
SURVEY ROUTES
TOWNSHIP 57 NORTH RANGE 23 WEST
Minnesota Steel Industries



Note:
No lynx trails or sign found in this township.

Figure 12
SURVEY ROUTES
TOWNSHIP 57 NORTH RANGE 22 WEST
Minnesota Steel Industries

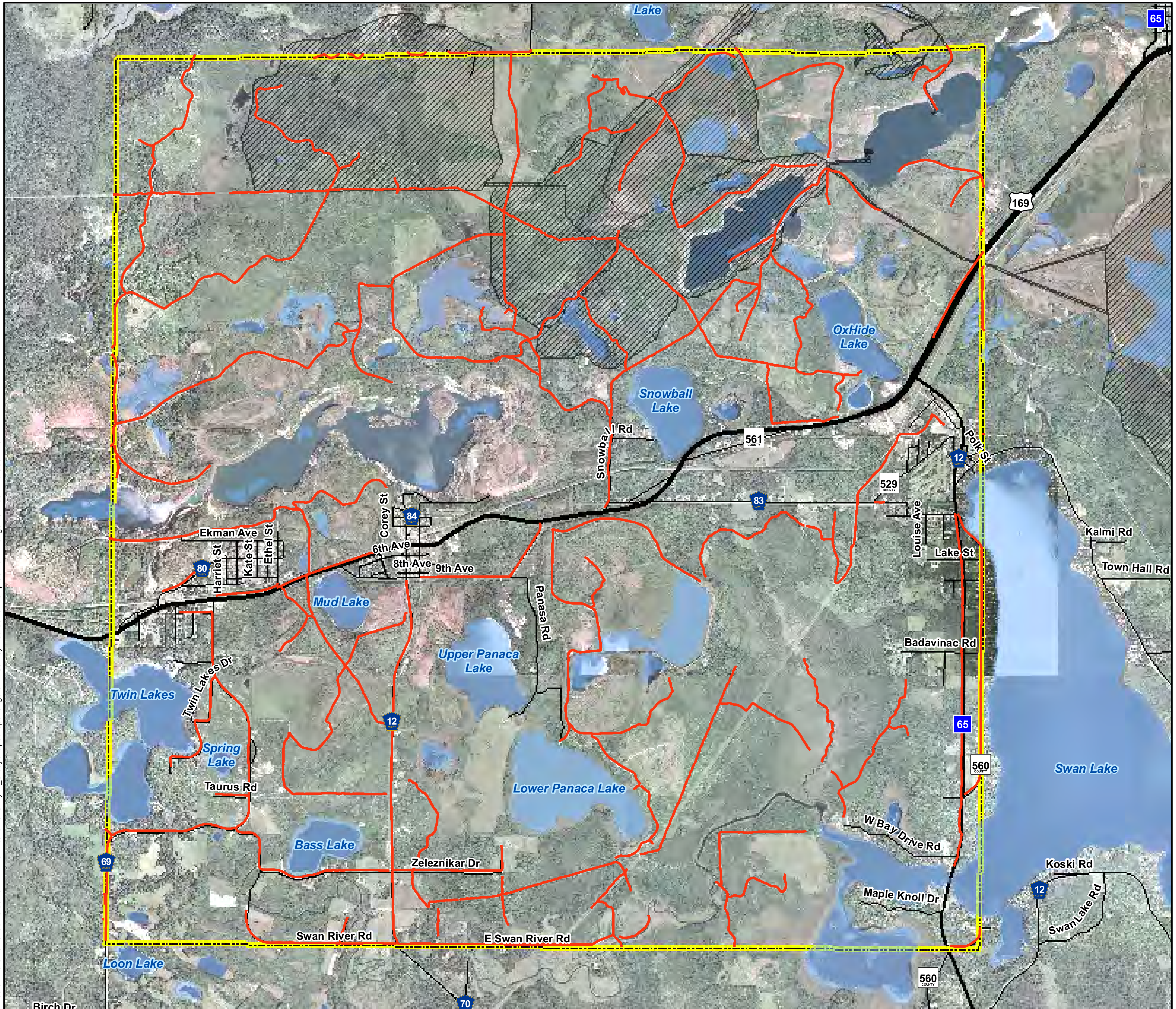


0 1,750 3,500 7,000
Feet

Survey Route
Township 56N Range 24W
Minnesota Steel Industries Project Areas

Note:
No lynx trails or sign found in this township.

Figure 13
SURVEY ROUTES
TOWNSHIP 56 NORTH RANGE 24 WEST
Minnesota Steel Industries



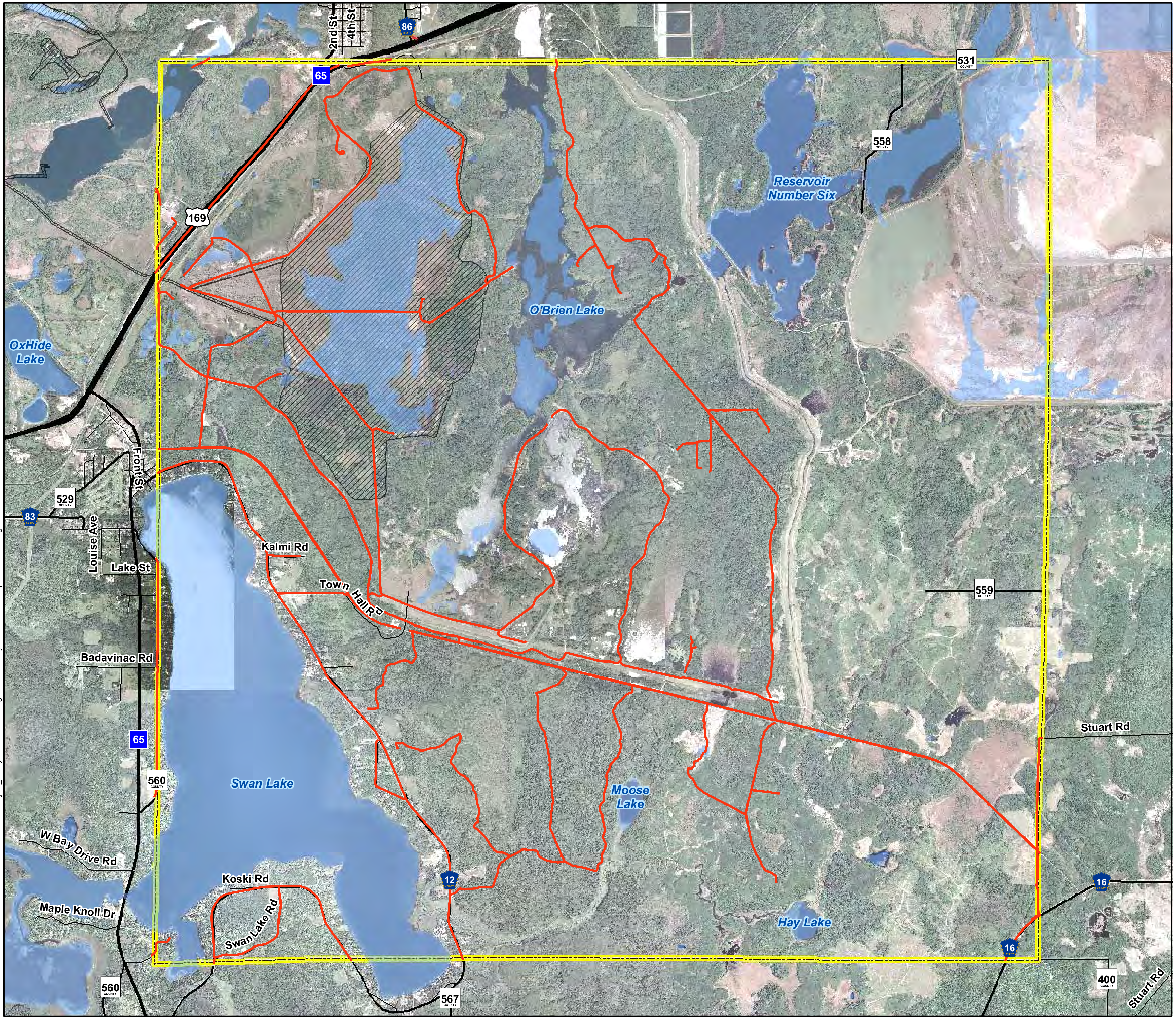
N

0 1,750 3,500 7,000
Feet

Survey Route
Township 56N Range 23W
Minnesota Steel Industries Project Areas

Note:
No lynx trails or sign found in this township.

Figure 14
SURVEY ROUTES
TOWNSHIP 56 NORTH RANGE 23 WEST
Minnesota Steel Industries

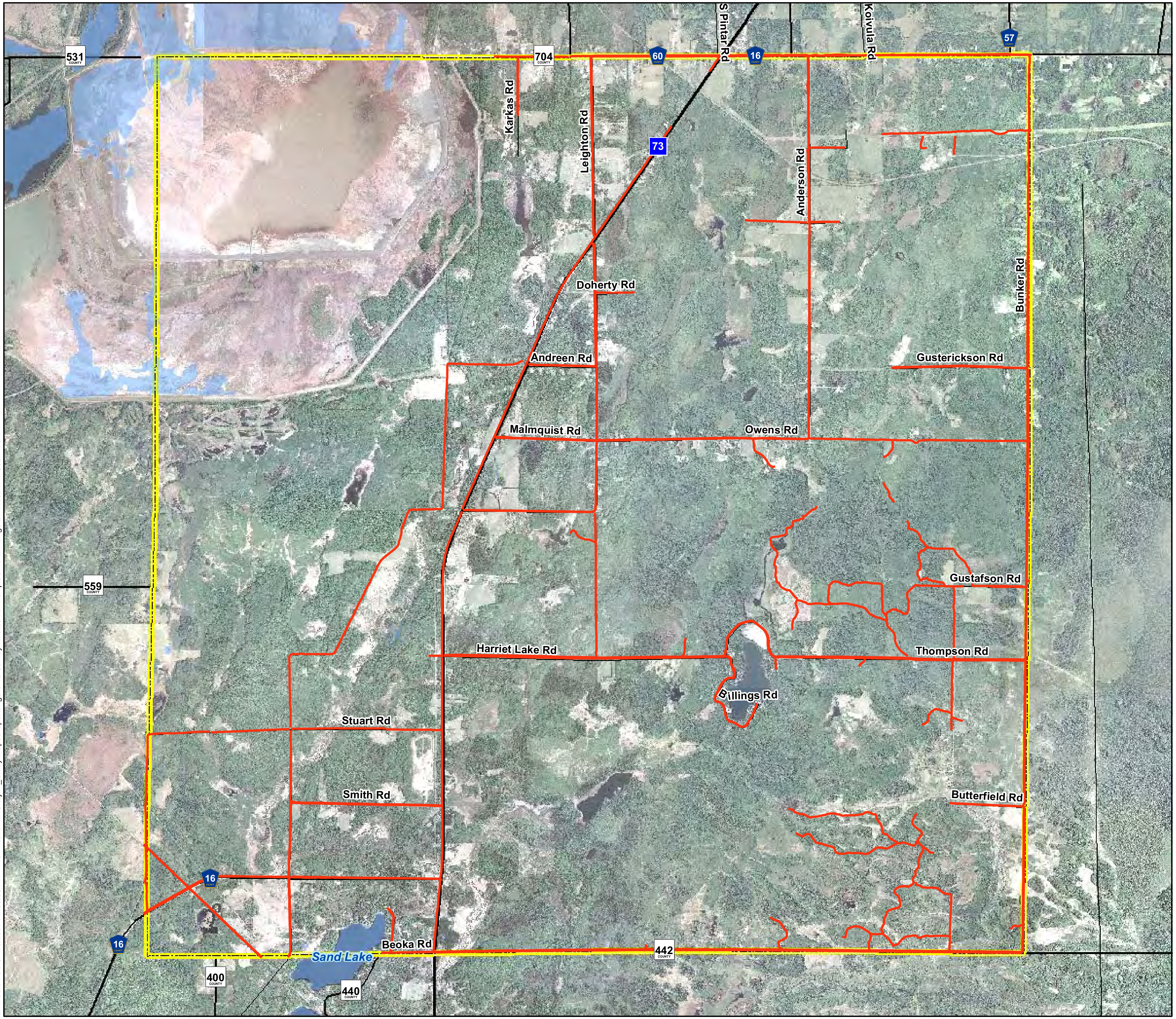


0 1,750 3,500 7,000
Feet

Survey Route
Township 56N Range 22W
Minnesota Steel Industries Project Areas

Note:
No lynx trails or sign found in this township.

Figure 15
SURVEY ROUTES
TOWNSHIP 56 NORTH RANGE 22 WEST
Minnesota Steel Industries



0 1,750 3,500 7,000
Feet

Survey Route

Township 56N Range 21W

Minnesota Steel Industries Project Areas

Note:
No lynx trails or sign found
in this township.

Figure 16
SURVEY ROUTES
TOWNSHIP 56 NORTH RANGE 21 WEST
Minnesota Steel Industries

Barr Footer: Date: 4/6/2007 12:39:08 PM File: I:\Client\MSI\Lynx_Study\Maps\Report\Figure 16 Survey Routes Township 56 North Range 21 West.mxd User: TJA

6.0 FACTORS AFFECTING CANADA LYNX AND THEIR HABITATS WITHIN THE STUDY AREA

6.1 Factors Identified in Final Rule

The USFWS concluded that the single biggest factor threatening the lynx in the contiguous United States is the inadequacy of existing regulatory mechanisms, specifically the lack of guidance for conservation of the lynx in National Forest and other resource management plans (Federal Register 2000). In addition, the USFWS noted that timber harvest and fire suppression impact lynx in the Great Lakes Geographic Area.

Lands under federal management are necessary to lynx conservation regionally and nationally, as federal lands often provide large amounts of forested habitat needed by lynx and snowshoe hare. Large tracts of National Forest lands are found approximately 10 miles (16 km) west (Chippewa National Forest) and 16 miles (26 km) northeast (Superior National Forest) of the study area. The George Washington State Forest is approximately 7 miles (11 km) north of the study area, and most of the lands not associated with Mesabi Iron Range mining and related activities are forests. These forestlands could provide important habitat for lynx that use the study area, and for movement of lynx between the study area and areas with higher densities of lynx to the northeast. In addition, Voyageur National Park has been identified as critical habitat for lynx; the park is approximately 75 miles (120 km) north of the proposed project site (Federal Register 2006).

6.2 Other Lynx Risk Factors

The *Lynx Conservation Assessment and Strategy* (Ruediger et al. 2000) identified several other risk factors for lynx in the contiguous U.S., which could also apply to lynx in or near the study area. These factors will be considered in the following section on the effects of the proposed action, and the cumulative effects of the project and other projects within or near the study area, on lynx. These include (**bolded items** considered important in study area):

1. Factors Affecting Lynx Productivity
   a. **Timber management**
   b. **Wildland fire management**
   c. **Recreation**
   d. **Forest/backcountry roads and trails**
   e. Livestock grazing
   f. **Other human developments (mining, power generation, etc.)**

2. Factors Affecting Lynx Mortality
   a. **Trapping**
   b. Predator control
   c. **Incidental or illegal shooting**
   d. **Competition and predation as influenced by human activities**
   e. **Highways (vehicular collisions)**

3. Factors Affecting Lynx Movements
   a. **Highways, roads, and ROWs**
   b. **Land ownership patterns**
   c. Ski areas and large resorts

4. Other Large-scale Risk Factors
   a. **Fragmentation and degradation of lynx refugia**
   b. Lynx movement and dispersal across shrub-steppe habitats

c. Habitat degradation by non-native invasive plant species

6.3 Current Non-federal Regulatory and Conservation Mechanisms within the Great Lakes Geographic Area

Within the Great Lakes Geographic Area, lynx are state listed as endangered in Michigan, protected as a wild animal in Wisconsin, and protected from harvest in Minnesota. Protection from legal harvest represents an important conservation benefit to lynx. Because most conservation actions are voluntary under these designations, no assurance of habitat protection can be attributed to state species designations.

7.0 POTENTIAL EFFECTS TO CANADA LYNX FROM THE PROJECT

The proposed project may affect lynx found in the vicinity of the project site, but the project would not adversely affect lynx populations or their critical habitat. The assessment of impacts is based on our limited knowledge of lynx use of the area (as discussed in Chapters 3 and 5), but assumes that based on results of this study, historic sightings, and habitat availability, that lynx likely do not reside in the study area. However, lynx could travel through the area and it is reasonably foreseeable that mine project activities could impact lynx traveling through the area. Proposed conservation measures would eventually restore some wildlife habitat to the site, but not to the same quantity or quality as the pre-disturbance condition. The following describes the likely effects of the project on lynx and their habitat. Conservation measures that could be undertaken by Minnesota Steel and conservation agencies and organizations to reduce effects to lynx are discussed in Chapter 8.

7.1 Determination of Effects

7.1.1 Types of Effects

Potential beneficial, direct, indirect, interdependent, and interrelated threats to the species that are unrelated to the proposed action, and that may result in cumulative effects as a result of the proposed action, are presented in this chapter (for a more detailed discussion of types of effects, see USFWS and National Marine Fisheries Service 1998). These effects are defined as follows:

- Beneficial – Effects of an action that are wholly positive, without any adverse effects, on a listed species or designated critical habitat.
- Direct – The direct or immediate effects of the project on the species or its habitat. Direct effects result from the agency action including the effects of interrelated actions and interdependent actions.
- Indirect – Effects caused by or resulting from the proposed action that are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action.
- Interdependent – Effects that result from an activity that has no independent utility apart from the action on consideration (pipelines and powerlines).
- Interrelated – Effects that result from an activity that is part of the proposed action and depends on the proposed action for its justification (e.g., mine supply traffic; increased housing for workers).
- Cumulative – The effects of future federal, state, tribal, local, or private actions that are reasonably certain to occur in the study area are considered in this assessment. Major actions could include Excelsior Energy's Mesaba Energy Project (if sited near Bovey) and ongoing mining and tailings disposal at Keewatin Taconite. A small portion of the proposed Phase II Trunk Highway 169 Cross Range Expressway near Bovey is within the area and is scheduled for completion in 2007.

The effects assessment is based on the risk factors identified in Chapter 6 and on the following factors:

- the dependency of the species on specific habitat components;
- habitat abundance;
- population levels of the species;
- the degree of habitat impact; and
- the potential to mitigate for the adverse effect.

7.1.2 Factors Affecting Lynx Productivity

7.1.2.1 Mine and Other Developments and Related Human Activity

Loss of habitat and disturbance would be the primary effects on lynx associated with the project. Based on GIS analysis, the project (excluding the tailings facility) would directly result in the loss of approximately 820 acres (330 ha) of wooded/forest habitat (MNDNR 2005a). Another 310 acres (126 ha; Stage I Tailings Basin) or 402 acres (163 ha; Alternative Tailings Basin) of wooded/forest habitat would be lost from construction of the tailings facility. Overall, approximately 1,130 to 1,220 acres (457 to 493 ha) of wooded/forested habitat would be lost. Loss of this habitat would reduce the amount of prey items and cover available to lynx traveling through the study area. Loss of habitat would also make it less likely that lynx would establish a territory within the study area, especially areas directly impacted by the mine project. Portions of the site would be reclaimed and reforested at mine closure, but potential lynx habitat would be lost for a period of 20 years, and it would likely be 20 or more years after mine closure before suitable lynx habitat would again occur in mine project disturbance areas. However, after reclamation, habitat may improve such that lynx could establish territories within the project area.

Light and glare, roads, and noise associated with the project could impact lynx. The mine project would operate 24 hours a day, 365 days per year, for up to 20 years. Light and glare would primarily be associated with plant buildings and structures, active stockpiles, and mine pits. Lynx traveling through the study area would likely avoid areas of the project that are active and well lit.

To date, most investigations of lynx have not shown human presence to influence how lynx use the landscape (Aubry et al. 2000). A possible exception is activity around a den site that may cause abandonment of the site, possibly affecting kitten survival (Ruggiero et al. 2000b). Anecdotal information (Roe et al.1999) suggests that individual lynx behave differently in response to the presence of humans and their associated activities, depending on the environmental setting in which the interaction occurs. Intuitively, some threshold exists where human disturbance becomes so intense that it precludes use of an area by lynx.

A variety of factors may influence the effects of mine and other developments and human activity on lynx. The following list helps evaluate how an activity might influence lynx.

1. *Type and quality of lynx habitat in which an activity occurs.* For instance, human activity in denning or diurnal security habitats may have a greater effect on lynx than activity in other habitat components.

2. *Time of year the activity occurs.* For example, fall hunting in lynx denning habitat may have far less effect than spring alpine skiing, cross-country skiing, or snowboarding in such habitat. Recreational facilities designed for summer time use, such as developed campgrounds or amphitheaters, most likely have very little effect on lynx.

3. *Time of day the activity occurs.* At developed facilities that receive high, concentrated human use during the day (e.g., commercial developments and industrial facilities), lynx may rest during the day in secure habitats while people use the remainder of the landscape. Lynx could emerge after dark to use the landscape when human activity has ceased or receded to acceptable levels. If extensive activities occur at night in lynx habitat, they may diminish or preclude habitat use by lynx.

4. *Type of activity.* The type of activity, pattern of human use, associated habitat impacts, and area of influence can affect the suitability of the landscape for lynx.

5. *Pattern of activity.* Some animals can adapt to predictable human activities. That is, if the activity generally occurs at predictable time periods at the same places or along the same routes, animals may become habituated to the activity. Response of the animal depends on the context within which a human/animal encounter takes place, the behavioral state of the animal, the type of human activity, and

the time and location of the recreational activity (Bowles 1995; Gutzwiller 1995; Gābrielson and Smith 1995; Knight and Cole 1995a, b).

6. *Intensity and frequency of activity.* How often the activity occurs and the number of people involved in the activity may influence the way lynx respond and use the surrounding environment. Encounters with a limited number of users might elicit a different behavioral response than frequent encounters with large groups of users.

Iron mining and processing are obviously heavy industrial operations and the source of various levels of noise and other disturbances. These activities have been part of the primary economic driver for northeastern Minnesota communities for many decades. Local wildlife are likely to be accustomed to the sound from normal mine project activities in the area. Noise impacts from Minnesota Steel mining would be expected to be similar to impacts experienced from the neighboring Keewatin Taconite operations.

Sections of the facility such as the pellet plant, DRI plant, and the steel mill are sources of noise. Noise from these sources would be relatively low-toned and constant, consistent with industrial fans, so it should present less annoyance than higher-pitched or variable tones of changing loudness.

Other sources of noise from the project site would include:

- chain saws and skidders used in clearing the project site
- blasting
- excavators and drills
- large trucks hauling and dumping rock
- backup alarms on mine excavators and trucks
- mine site warning sirens
- over-the-road diesel trucks
- trains hauling ore
- train whistles

In general, noise levels would not exceed 90 A-weighted decibels at the project boundary. The impacts of noise on lynx and other wildlife are largely unknown and the assessment of impacts remains subjective. Wildlife are receptive to different sound frequency spectrums, many of which may be inaudible to humans. Wildlife also are known to habituate to noise, especially noises that are steady or continuous, such as noises that would occur at the mill. Wildlife are less likely to habituate to sudden, infrequent impulse noises. Mine project noise could cause lynx to avoid areas near the mine project during their travels through the study area, although these impacts to lynx would be minor given the limited number of lynx likely to use the area.

The mine project would employ about 700 workers. Although some workers currently reside near the mine, other workers will move to the area. New housing and other infrastructure would be required to support these new workers. Other industrial facilities proposed for development near the study area (most notably the Excelsior Energy Coal Gasification Facility) would also increase the number of people living in or near the study area, and along with normal population growth, would result in conversion of wooded/forested habitats more suitable for lynx to developed uses that provide few habitat values for lynx. It is likely that ongoing and future development and disturbances within and near the study area would reduce the suitability of the area to provide habitat and travel corridors for lynx. State and federal forestlands near the study area would continue to provide a refuge for lynx, and it is likely the lynx would favor these areas over those within the study area.

7.1.2.2 Timber Management

Nearly all forestlands on the project site (i.e., mine, plant stockpiles, and tailings basin) would be removed. Forest management practices such as thinning, commercial harvest, and post harvest treatments would continue to occur at irregular intervals on non-project lands within the study area and would influence habitats for lynx and prey. As described previously, snowshoe hares may reach highest densities in young, dense coniferous or coniferous-deciduous forests, or mature forests with a dense understory of shrubs, aspen, and/or conifers. Red squirrels appear to be most abundant in mature cone-bearing forests. Lynx natal dens, described by Berrie (1974), Kesterson (1988), and Koehler (1990) are generally located in areas with large quantities of coarse woody debris, such as blowdown and root wads, which may occur in mature forests or in regenerating stands.

Timber harvest is not an exact ecological substitute for natural disturbance processes. For example, timber harvest may result in the following:

- removal of most standing biomass, especially larger size classes of trees, from the site;
- a decrease in the amount of coarse woody debris available for cover and denning;
- smaller, more dispersed patch sizes and concentrated harvest, resulting in a greater degree of habitat fragmentation;
- selective removal of particular tree species;
- soil disturbance and compaction by heavy equipment, which may result in increases of exotic plants that can compete with native vegetation;
- harvest, planting and thinning treatments that may give a competitive advantage to certain tree species; and
- construction of roads that may be used during winter as designated or groomed travel routes for snowmobiles or cross-country skiers.

Loss of forestlands and associated overstory and understory vegetation and cover from mine project construction and development would make these areas unsuitable for use by lynx, although these impacts to lynx would be minor given the limited number of lynx likely to use the study area. However, forest management practices outside of the mine project footprint that improve habitat for snowshoe hare and other lynx prey species would benefit lynx traveling through the study area.

7.1.2.3 Wildland Fire Management

Fire, wind, insects, and disease historically played an important role in maintaining the mosaic of forest successional stages that provide habitat for both snowshoe hare and lynx (Fox 1978; Bailey et al. 1986; Quinn and Thompson 1987; Koehler and Brittell 1990; Poole et al. 1996; Slough and Mowat 1996). For the first few years after a burn, there appears to be a negative correlation between lynx use and the amount of area burned (Fox 1978). This short-term effect is likely the result of reduced snowshoe hare populations, removal of cover, and possibly increased competition from coyotes in open habitats (Stephenson 1984, Koehler and Brittell 1990). The lag time until the peak of hare population increase is generally about 15 to 30 years (this varies depending on tree species, habitat type and severity of disturbance). Re-sprouting of broadleaf species occurs more quickly, in 3 to 12 years. Hare populations again decrease as the forest canopy develops and shades out the understory. Forest gap processes, such as large blowdowns, insect infestations, and outbreaks of disease, produce effects similar to those associated with fire (Agee 2000).

Areas with suitable lynx habitat in the Great Lakes Geographic Area boreal forests historically tended to have relatively short fire return intervals of 50 to 150 years. Disturbance interval and fire severity varied by cover type, with xeric pine types such as jack pine typically experiencing more frequent and more severe fires than mixed conifer types and spruce/fir.

Because much of the study area has been developed, or is in pastureland or forestland production, the likelihood of wildland fires being allowed to burn over large acreages is low. Over time, continued fire exclusion alters vegetative mosaics and species composition, and may reduce the quality and quantity of habitat for snowshoe hares.

Salvage logging following wildfires and other disturbances, such as windstorms and insect outbreaks, may negatively affect habitat for lynx and lynx prey if most large-diameter trees are removed. After they fall to the ground, large dead trees are important in providing cover for foraging in the short term and potentially for denning habitat in the longer term, depending on post-fire stand conditions.

The mine project would have little or no influence over forest and fire management activities in the study area. Even after mine project reclamation, it is unlikely that fires would be allowed to burn uncontrolled on the project site, although prescribed burning could possibly be used on inactive portions of the site to improve habitat for lynx and other wildlife.

7.1.3 Recreation

Recreational activities are becoming increasingly more widespread across the landscape, but their effects on lynx are little known. Very few studies have investigated the complex interactions between humans and wildlife. Some anecdotal information suggests that lynx are quite tolerant of humans and that a wide variety of behavioral responses to human presence can be expected (Staples 1995; Roe et al. 1999; Mowat et al. 2000).

Nonconsumptive recreational activities are growing in popularity over the more traditional consumptive recreation uses of hunting and fishing (Duffus and Dearden 1990). Trends indicate that land-based activities occurring within developed recreation sites or near roads involve the greatest number of people. However, there have been vast improvements in bicycle and off-road vehicle technology, as well as a growing popularity in motorized off-road activities, including snowmobiling. Although the project would not be used for recreational purposes, natural population growth, along with an influx of workers to support the mine project, would further increase the growth of recreational activity in the study area and could possibly impact lynx movements within the area.

Lynx and carnivore biologists (Bider 1962; Ozoga and Harger 1966; Murray and Boutin 1991; Koehler and Aubry 1994; Murray et al. 1995; Lewis and Wenger 1998; Buskirk et al. 2000) have suggested that packed trails created by snowmobiles, cross-country skiers, snowshoe hares, and predators may serve as travel routes for potential competitors and predators of lynx, especially coyotes. Buskirk et al. (2000) hypothesized that the usual spatial segregation of lynx and coyotes may break down where human modifications to the environment increase access by coyotes to deep snow areas. Such modifications include expanded forest openings throughout the range of the lynx.

Fuller and Kittredge (1996) noted that the distribution and numbers of coyotes have dramatically expanded in recent decades. Geir (1975) and Nowak (1979) suggested that coyotes are thought to have originated in areas where snow cover was minimal, and it is only within the last century that they have colonized the boreal forests.

Buskirk et al. (2000) hypothesized that coyotes may be locally or regionally important competitors for lynx food resources, possibly exerting interference competition pressures on lynx as well. O'Donoghue et al. (1998b) also suggested coyotes exert potentially important exploitation competition pressures on lynx. Predation rates by coyotes on snowshoe hares exceeded those of lynx in the Yukon Territories during hare highs. Coyotes then shifted their prey preference from snowshoe hares to carrion because of intolerance to deep snow conditions (Todd et al. 1981). Coyotes have been shown to increase their use of open habitats between November and March due to the increase in packed snow conditions and the load-bearing strength of snow in openings. It is this strong prey- and habitat-switching ability of the coyote that may contribute to its success as a competitor with lynx (Buskirk et al. 2000).

Murray and Boutin (1991) reported that both lynx and coyotes used travel routes with shallow snow, but that coyotes traveled on harder snow more frequently. They also reported that the use of trails in the snow not only reduced the depth to which an animal sinks into the snow, but aided coyotes and lynx in obtaining additional food. Keith et al. (1977) suggested that during peak highs of hares, the density of trails in snow facilitates coyote movement. Murray and Boutin (1991) reported similar results with their study where hare densities were high.

Recreational snowmobile use has expanded dramatically over the past 25 years, and is a common recreational activity in northern Minnesota. The growth of snowmobile use and an expanded trail system over the past 2 to 3 decades has increased human presence in lynx habitat in northern Minnesota and elsewhere in the United States. The impacts of this activity to lynx that may be found near the project site would be minor given the limited number of lynx likely to use the study area.

7.1.4 Forest/Backcountry Roads and Trails

A well-established road system is associated with mining activity along the Mesabi Iron Range, and to serve nearby towns, recreational areas, private residences, and pasturelands and forestlands. It is expected that the number of miles of roads within the study area would increase during the life of the mine project, although some roads, especially those used for timber harvest, could be taken out of service or reclaimed during the life of the project.

Current project conceptual plans are for a county highway to be constructed from Highway 169 to the west end of the project plant site (MNDNR 2005a). County Highway 58, which runs along the north site of the proposed plant site, would serve as a major access route for employees entering from State Highway 65, east of the plant. After the mine project was operational, County Highway 58 would be terminated at the plant site.

There is little information available on the effects of roads and trails on lynx or its prey (Apps 2000; McKelvey et al. 2000d). Construction of roads may reduce lynx habitat by removing forest cover. On the other hand, in some instances, along less-traveled roads where vegetation provides good snowshoe hare habitat, lynx may use the roadbed for travel and foraging (Koehler and Brittell 1990).

Roads and trails may facilitate snowmobile, cross-country skiing, and other human uses in the winter. As described previously in the recreation section, snow compaction on roads or trails may allow competing carnivores, such as coyotes and mountain lions, access into lynx habitat (Buskirk et al. 2000). In the absence of roads and trails, snow depths and snow conditions normally limit the mobility of these other predators during midwinter.

Recreational, administrative, and commercial uses of roads are known to disturb many species of wildlife (Ruediger 1996). However, preliminary information suggests that lynx do not avoid roads (Ruggiero et al. 2000a), except at high traffic volumes (Apps 2000). Lynx were often seen crossing roads near the NorthMet Mine Site, near Babbitt, Minnesota, during winter lynx surveys in 2006. It is possible that summer use of roads and trails through denning habitat may have negative effects if lynx are forced to move kittens because of associated human disturbance (Ruggiero et al. 2000b).

At this time, there is no compelling evidence to suggest management of road density is necessary to conserve lynx, and the increase in road density associated with the mine project and future growth in the study area should have little effect on lynx movements in the area. Still, lynx may be more vulnerable to human-caused mortality near open roads (Koehler and Aubry 1994). This risk is discussed in the following section (Factors Affecting Lynx Mortality).

7.2 Factors Affecting Lynx Mortality

7.2.1 Trapping

There is evidence that lynx may be accidentally trapped during furbearer, including fisher, marten, and bobcat, trapping seasons. Of the 435 records in the MNDNR (2007) lynx database for 2000 to 2006, 10 records list that the animal was caught in a trap, and of these, 3 were killed, 6 were released unharmed, and the status of one is unknown. It is likely that other lynx have been trapped, but not reported. None of the records were from Itasca County. The magnitude of accidental lynx trapping in the study area and in northern Minnesota is unknown.

7.2.2 Incidental or Illegal Shooting

Lynx could be shot mistakenly or intentionally by hunters or by poachers. Lynx may be shot by hunters during deer and other hunting seasons for fun, or may be mistakenly identified as bobcat and shot during the bobcat season. The actual magnitude of shooting in northern Minnesota is unknown. Of the 435 records in the MNDNR (2007) lynx database for 2000 through 2006, only one record lists that the animal was intentionally shot, while another lynx was accidentally shot. However, it is likely that lynx shootings are generally not reported. It is unlikely that many lynx would be shot within the study area due to limited numbers of lynx in the general vicinity of the mine project.

Education of the public as to the importance of protecting lynx and other wildlife has helped to reduce the accidental or intentional loss of lynx in recent years.

7.2.3 Competition and Predation as Influenced by Human Activities

Lynx interact with other carnivores throughout their range. Competition with or predation by coyotes, gray wolves, mountain lions, bobcats, and birds of prey have been inferred or documented throughout the range of the lynx. Some human activities, particularly those related to timber harvest and over-the-snow access routes, have the potential to alter natural relationships between lynx and other predators.

Gray wolves were extirpated from the continental United States, except Minnesota, by 1960 (Thiel and Ream 1995). Much of this effort was carried out through government control programs to protect ungulates and halt the spread of rabies (Paradiso and Nowak 1982). Recently, wolf populations have rebounded in Minnesota, Wisconsin, the Upper Peninsula of Michigan and Montana, and have been reintroduced into central Idaho and the Yellowstone ecosystem.

Coyotes have expanded their range in recent decades (Fuller and Kittredge 1996), and coyotes may have expanded their range and increased in numbers as wolves were reduced in range and number. Crabtree and Sheldon (1999) also reported that in some areas of the contiguous U.S., wolves are increasing in numbers and distribution, while coyotes are decreasing in response.

Certain timber harvest practices increase edges and openings within forest stands, which may improve foraging conditions for generalist predators such as coyotes, bobcats, and great horned owls (*Bulbus virginianus*). This in turn increases the potential for both exploitation and interference competition with lynx to occur. Based on results of this study, at least four bobcats use the study area.

As described previously (in the Recreation section), snow compaction due to resource management or recreation activities may facilitate movement of coyotes and other potential competitors and predators into lynx habitat, making it likely that lynx in the study area would compete with these competitors and predators for primary lynx prey (Buskirk et al. 2000).

7.2.4 Highways (Vehicular Collisions)

There are few records of lynx being killed on highways, but direct mortality from vehicular collisions may be detrimental to small lynx populations in the lower 48 states. Of the 435 verified, potential, and unverified lynx observations in the MNDNR (2007) database for 2000 to 2006, there are five records of lynx being killed by a vehicle, and one record of a lynx being killed by a train; none of these lynx were killed in Itasca County.

Traffic volumes that affect lynx mortality and dispersal have not been studied. However, a study of carnivores on highways in Canada suggest that highway traffic volumes of 2,000 to 3,000 vehicles per day are thought to be problematic. Traffic volumes of 4,000 vehicles or more per day are considered to be serious impacts in terms of both mortality and habitat fragmentation (Clevenger and Alexander 1999). Railroads, especially when paralleling major highways, increase both the mortality risks and habitat fragmentation (Gibeau and Heuer 1996, Woods and Munro 1996).

Attempts to mitigate highway losses by signing, reducing speed limits, and public education have had little or no effect on decreasing the losses of large ungulates and carnivores in Banff National Park, Canada, or of the Florida panther (*Felis concolor*). One measure that appears to reduce highway mortality is the construction of wildlife fencing and associated underpasses or overpasses. Lynx use of highway underpasses constructed in Banff National Park has been documented (Heuer 1995). No wildlife underpasses or overpasses have been constructed within the southern portion of lynx range with the objective of facilitating movement of carnivores.

Lynx injury and death could occur from increased traffic volume on the roads associated with the project. However, the risks are low because of the few, if any, lynx likely to be found near the project site. As traffic, in general, increases in the study area over time, and if lynx populations expand in the region, it is likely there would be future lynx-vehicle collisions.

Rail access to the site would occur by connecting to the rail lines along Highway 169 near Taconite (MNDNR 2005a). As noted above, lynx have been killed by trains and increased rail traffic in the study area would increase the potential for train-lynx collisions, though it would still be very low.

The risks to wildlife of a spill during the transport of materials used for maintenance and operation of the project site, and during storage and use of the materials at the project, would depend on the location of the spill and types and amounts of materials spilled. Potentially toxic compounds used in concentration processes include an amine collector and petroleum-based products (MNDNR 2005a). The impacts of an accidental spill to lynx that may be found near the mine project site would be minor given the limited number of lynx likely to use the study area.

7.3 Factors Affecting Lynx Movements

7.3.1 Highways, Roads, and Rights-of-way

Highways can alter landscapes by fragmenting large tracts of land, some of which were previously homogenous habitats. Highways typically follow natural features such as lakes, rivers, and valleys that may have high habitat value for lynx. As the standard of road increases from gravel to 2-lane highways, traffic volumes increase. Lynx and other carnivores may avoid using adjacent habitat or become intimidated by highway traffic and may not cross (Gibeau and Heuer 1996). The degree of impact increases as highways are upgraded from 2 lanes to 4 lanes. Four-lane highways, such as the Interstate Highway System, commonly have fences on both sides, service roads, paralleling railroads and impediments like "Jersey Barriers" that make successful crossing more difficult, or impossible. Highways can also directly affect the amount of feeding and denning habitat available to lynx by converting natural forests into road surface, rights-of-way, or associated facilities such as maintenance areas or gravel pits.

Utility corridors can have impacts to lynx habitats, depending on location, type (e.g., gas pipelines, power lines), vegetation clearing requirements, and maintenance access. The primary effect is to disrupt connectivity of lynx habitat. When located adjacent to highways and railroads, utility corridors can further widen the rights-of-way, thus increasing the likelihood of impeding lynx movement. Remote, narrow utility corridors may have little or no effect on lynx, or could even enhance habitat in certain vegetation types and conditions.

Of 15 lynx records for Itasca County, 9 were made by observers traveling roads or other rights-of-way, including Highway 2, a well-traveled road. As noted earlier, lynx do cross roads, and lynx tracks were often seen on roads during surveys at the NorthMet Mine Project near Babbitt, Minnesota. However, lynx tracks usually went in a nearly straight line from one side of the road to the other.

Roads would be constructed for the project, although their impact on lynx should be minor, given the other habitat loss and disturbance associated with the project and limited number of lynx found near the proposed mine project site. Other roads constructed in the study area have the potential to disrupt habitat homogeneity, although much of the study area consists of fragmented habitat due to historic land disturbances, including mining and logging activity. Thus, it is likely that these activities would impact lynx traveling in the study area, but effects on lynx movements and habitat use would be minor.

7.3.2 Land Ownership Patterns

Lynx exemplify the need for landscape level ecosystem management. Land and population management must cross international, federal, state, county, and private land boundaries, as lynx are wide ranging. Coordination within and between agencies and other landowners has often been difficult. In situations where habitat connectivity is needed to maintain adequate populations, private land development may preclude use by lynx, and may interrupt the connectivity of habitat and populations. Habitat fragmentation also may impede lynx movements, which in turn could isolate lynx and/or prey populations, or retard movements to other areas.

Contiguous tracts of land in public ownership (e.g., national and state forests and parks) provide an opportunity for management that can maintain lynx habitat connectivity. Throughout most of the lynx range in the lower 48 states, connectivity with habitats and source populations in Canada is critical for conserving populations. The size, amount, and spatial distribution of federal land vary considerably from west to east across the United States.

In both the Great Lakes and the Northeast geographic areas, the ability to provide necessary connectivity is made more difficult by current land ownership and land use patterns between tracts of lynx habitat occurring on National Forests. In both areas, dispersing animals must traverse significant areas of non-federal lands to access lynx habitat occurring on National Forest lands.

Because of past mining activity, much of the land associated with the Mesabi Iron Range is heavily disturbed. Large areas nearly devoid of vegetation, including tailing facilities and waste rock piles, are readily observed near the project site. Although disturbed areas that are no longer mined have become revegetated, natural revegetation can take decades on tailings and waste rock sites. Most non-mine development and associated land development in the region is also associated with the east-west trending Mesabi Iron Range, although lynx travel across this disturbance area to reach habitats to the north and south. Mine and other development in the region may cause lynx to move in a more east-west pattern.

Lynx would be able to move to the north relatively easily, even though much of the land within and near the study area is privately owned. Land to the north (and also to the south) of the study area is primarily second growth forest, shrublands, and wetlands. It is anticipated that most of this land will remain forested for decades, although some forestland will be converted to residential and developed land as the population grows. The Chippewa Forest is approximately 10 miles west of the project site, and probable (4) and unverified (5) sightings of lynx have been made in that forest. The Superior National Forest is approximately 16 miles to the east of the project site, and numerous verified lynx sightings, and evidence of lynx reproduction, have been recorded in the Superior National Forest. Based on the pattern of lynx sightings (Figure 5), it appears that if lynx found near the project site left the area, they would likely move toward the east or northeast where lynx sightings are greater and more suitable habitat may be found.

7.4 Other Large-scale Risk Factors

7.4.1 Habitat Fragmentation and Travel Routes

The proposed project would increase the amount of habitat fragmentation in the area, changing wooded/forested and other vegetated habitats to disturbed/developed areas with little or no habitat value. As noted above, development of iron mines along the Iron Range has made much of this area of limited value to lynx, especially areas with pits, tailings, and waste rock piles. Historic waste rock piles and tailings have begun to revegetate and provide some habitat for lynx and their prey, but their value is greatly reduced compared to habitat that existed in the area prior to mining. Because much of the project would occur in areas of old workings or tailings, the amount of new habitat loss and fragmentation associated with the project would be small in the context of available habitat within the study area and region and effects to lynx would be minor.

A common strategy to avoid excessive habitat loss and overexploitation of wildlife populations has been to provide "refugia." Weaver et al. (1996) suggested that large carnivores (grizzly bears *[Ursus arctos]*, gray wolves, mountain lions, and wolverines) require some form of refugia. The characteristics, size, and distribution of refugia that are needed vary depending on the species. In general, refugia are defined as large, contiguous areas encompassing the full array of seasonal habitats that are connected to each other across landscapes.

McKelvey et al. (2000d) argued that a system of reserves embedded in a fragmented and non-natural landscape would not be sufficient to sustain lynx populations. Rather, a strategy that encompasses the entire landscape may be necessary.

Refugia have been recommended for lynx to avoid over-harvest by trapping (Ward and Krebs 1985; Bailey et al. 1986). Refugia must be large enough to protect a proportion of the local population (Poole 1994). Although the minimum size is unknown, evidence from Alaska and Manitoba indicate that areas as large as 1,170 mi^2 (3,000 km^2) may not be large enough for cyclic and heavily exploited populations (Carbyn and Patriquin 1983; Bailey et al. 1986). In northcentral Washington, a lynx population of about 25 lynx has persisted in an area of about 700 mi^2 (1,800 km^2); this area is connected to additional lynx habitat and populations in Canada.

Given its susceptibility to human-caused mortality (e.g., trapping) and relatively specialized foraging strategy, refugia were identified as a possible element in a long-term conservation strategy for the lynx. The identification of refugia will undoubtedly require the coordination and cooperation of a variety of landowners, both public and private.

The MNDNR assessed potential cumulative effects to wildlife habitat and travel corridors from mine and other development associated with the Mesabi Iron Range. The mine project facilities would be located in portions of Travel Corridor #3 (primarily in Township 56 North, Range 23 West), including the mine area, stockpiles, and crusher and concentrator. The largest contiguous area of mine disturbance would be approximately 2 miles (3.2 km) in length. Lynx approaching the mine project site from the north or south would have to travel up to 2 miles (3.2 km) to reach the eastern or western boundary of the project and then continue their travel in a northerly/southerly direction. However, approximately half this distance is presently occupied by a mine pit lake, and thus lynx traveling in this area are already required to travel a mile (0.8 km) to traverse around the lake. Thus, the proposed project may increase the distance lynx must travel by about a mile from current travel distances for lynx to access habitats to the north or south of the project area.

Based on habitat assessments done during this study, suitable lynx habitat in Township 56 North, Range 23 West is primarily limited to the northwestern and southeastern portions of the township. Thus, lynx may move in a generally southeasterly/northwesterly direction through this township to access suitable habitat. If so, lynx would likely travel to the west of the mine project and the mine project would be a minor impediment to lynx movements to the north and south in this area.

As noted above, the number of lynx likely to use the study area is small compared to areas east of the project, probably reflecting the high level of disturbance found in the area due to past and ongoing mining activities. Although forestland dominates in the southern and northern portions of the study area, much of the land has been developed for residential or commercial uses, clear-cut or converted to younger forest stands, or used for agriculture, making these areas less suitable for lynx. The nearest large stands of forested habitat are associated with the Chippewa and Superior National Forests. It is unlikely that the study area would ever be included within a lynx refugia that includes these National Forests. However, the northern portion of the study area may provide a travel corridor for lynx moving between these two forests.

8.0 CONSERVATION MEASURES

Six measures are recommended as conservation measures for potential impacts to lynx from the proposed project. These measures are based, in part, on conservation measures identified in the *Lynx Conservation Assessment and Strategy* (Ruediger et al. 2000) that are applicable to lynx populations throughout the contiguous U.S. and could therefore apply to lynx in the study area.

Because limited research has been conducted on lynx in the contiguous United States, the first conservation measure would be to continue to follow studies of lynx conducted by the Forest Service, NRRI, MNDNR, and other conservation agencies and groups to better understand lynx use of the study area during mine project construction and operation, and to identify specific reclamation measures that could be implemented to restore lynx habitat to the area after mining ceases. Additional conservation measures that are recommended if the project is approved include: 2) reclaiming the project site to habitats favored by lynx and other wildlife; 3) maintaining vegetated buffers around the project site to reduce impacts to lynx from light and noise, where feasible; 4) closing the site to recreation or restricting site access for recreation during development, operation, and reclamation; 5) minimizing the number of roads constructed and reclaiming roads upon mine project closure; and 6) educating mine project workers on the need to observe speed limit and other mine regulations, and educating the public to take measures to protect lynx and other wildlife. These measures are discussed in more detail below.

These conservation measures are written to support management of lynx and their habitat. However, given the limited knowledge about lynx in the study area, many of the recommendations were drawn from knowledge about their primary prey (snowshoe hares) and important alternate prey (red squirrel, ruffed grouse), other forest carnivores, and basic principles for maintaining or restoring native ecological processes and patterns. A benefit of this approach is that it should enhance compatibility with the needs of other species that inhabit the same ecosystem.

8.1 Reclaim Project Site

The mine project would modify wildlife habitat on portion of the mine project site. Although most habitat associated with the mine project footprint is of marginal value, it could become of greater value over time in the absence of new disturbance.

An important goal of reclamation would be to restore portions of the proposed project site to productive uses for lynx and other wildlife. As discussed in the Minnesota Steel's Permit to Mine Application, reclamation of the site would comply with specific requirements identified in Minnesota Rule Chapter 6130. This rule requires that landforms be designed and constructed to complement nearby natural terrain, minimize adverse water quality and quantity effects on receiving waters, enhance the survival and propagation of vegetation, be structurally sound, control erosion, promote early completion and progressive reclamation, and encourage the prompt conversion from mining to an approved subsequent use. At least 2 years prior to deactivation of any portion of the mining area, proposed subsequent uses shall be presented to the MNDNR commissioner for approval. The proposed uses shall be selected based on:

- compatibility of adjacent uses;
- the needs of the area;
- the productivity of the site;
- projected land use trends;
- public health and safety;
- preventing pollution of air and water; and
- compatibility with local land use plans and plans of the surface owners.

The purpose of mine project land reclamation is to control adverse environmental impacts, plan for future land use, and promote orderly mining that will encourage good mining practices and recognize the beneficial aspects of mining.

Upon mine project site closure, much of the site would likely be reclaimed to wooded/forested habitat. Although it could take decades for reclaimed areas to provide suitable habitat for lynx and their prey, timber management practices conducted on the site after closure that maintain or enhance habitat for snowshoe hare and alternate prey such as ruffed grouse and red squirrel would be beneficial. Reclaiming sites using deciduous and conifer tree species can also create good cover for snowshoe hare. Reclamation of the site would be enhanced if Minnesota Steel evaluates historical and current conditions and landscape patterns to develop vegetation mosaics within the reclaimed area that are beneficial to lynx and other wildlife and are conducive to promoting movement of wildlife throughout the study area and region. Given that past (and proposed) mining has led to fragmentation of habitat within and near the study area, management activities that produce forest composition, structure, and patterns similar to those that would have occurred under historical disturbance regimes would benefit lynx and their prey. Minnesota Steel could also encourage nearby landowners to manage their forest stands to benefit lynx and other wildlife, and to help maintain habitat connectivity between the study area and nearby national and state forests to provide future habitat for lynx and allow for the movement of lynx between private and public lands.

Lynx exemplify the need for landscape-level ecosystem management. Contiguous tracts of land in public ownership (e.g., national and state forests) provide an opportunity for management that can maintain lynx habitat connectivity. Throughout most of the lynx range in the lower 48 states, connectivity with habitats and populations in Canada is critical for maintaining populations in the United States.

As discussed earlier, the study area may provide a corridor for lynx movement between the Chippewa National Forest to the west and Superior National Forest and Canada to the east/northeast. The study area may not contain high quality lynx habitat, based on the limited number of sightings of lynx within the area. However, the area may serve as a travel corridor, whose importance may increase if lynx populations continue to grow and expand within northern Minnesota.

Efforts undertaken by Minnesota Steel to minimize habitat disturbance during mine project development, and to reclaim disturbed lands to wooded/forested habitat, would help ensure that habitat fragmentation is minimized and large blocks of lynx habitat remain within the study area. Although it is unlikely that the study area will ever serve as refugia for lynx, given the high level of human activity within the area, it can continue to serve as an important travel corridor for lynx moving between state and national forests.

8.2 Maintain Vegetated Buffers

Where feasible, the mine facility should be designed to minimize impacts to lynx by minimizing the disturbance area and sequentially reclaiming areas as mine activities cease. Where feasible, a vegetative buffer should be retained around the perimeter of the mine project to reduce light and noise effects on nearby lynx. In addition, existing and newly constructed roads (built to access project site) should be reclaimed or obliterated after mine project closure, where feasible.

8.3 Limit Public Access to Project Site

The project site would be closed to recreation during development, operation, and reclamation. If public access was allowed after closure and reclamation, activities that compact snow should be discouraged in areas that have been identified/managed as potential lynx habitat. In addition, Minnesota Steel should work with Itasca County and other private and public landowners within the study area to encourage them to minimize or preclude snow compacting activities on little-used roads and other rights-of-way, where feasible.

Lynx have evolved a competitive advantage in environments with deep soft snow that tends to exclude other predators during the middle of winter, a time when prey is most limiting (Murray and Boutin 1991; Livaitis 1992; Buskirk et al. 2000). Widespread human activity (snowshoeing, cross-country skiing, snowmobiling, all-terrain vehicles) may lead to patterns of snow compaction that provide additional advantage to competing predators such as coyotes and bobcats to occupy lynx habitat through the winter, reducing its value to and even possibly excluding lynx (Bider 1962; Ozoga and Harger 1966; Murray et al. 1995; O'Donoghue et al. 1998b).

8.4 Minimize Road Construction and Reclaim Unused Roads

Where feasible, dirt and gravel roads traversing lynx habitat within the mine project area should not be paved or otherwise upgraded (e.g., straightening of curves, widening of roadway, etc.) in a manner that is likely to lead to significant increases in traffic speeds or increased width of the cleared rights-of-way, or would foreseeably contribute to development or increases in human activity in lynx habitat within the mine project area.

Plowed roads and groomed over-the-snow routes may allow competing carnivores such as coyotes to access lynx habitat in the winter, increasing competition for prey (Buskirk et al. 2000). However, plowed or created snow roads would be necessary to access mine facilities during construction and operation, and are necessary to access on other lands within the study area.

Preliminary information suggests that lynx may not avoid roads, except at high traffic volumes. Therefore, at this time, there is no compelling evidence to recommend management of road density to conserve lynx. However, the number of new roads constructed in support of the project, and for other activities within the study area, should be minimized and roads reclaimed/obliterated where feasible.

8.5 Educate Mine Workers and Public

Direct mortality from vehicular collisions has been detrimental to lynx in northern Minnesota, including nearby St. Louis County. It is unlikely that lynx would travel close to the project due to disturbance and lack of habitat, but individual lynx could be hit by vehicles in other portions of the study area. To benefit lynx and other wildlife, speed limits would be enforced along mine project access roads to reduce the risk of wildlife-vehicle collisions. Mine workers would be given training to make them aware of the importance of the area to wildlife, to request that employees report sick or dying wildlife along roads or at facilities, to ensure that employees do not dump wastes or other harmful materials off the site, and to make employees aware of other actions that could be harmful to wildlife or their habitats.

Lynx may be mistakenly trapped or shot by legal predator hunters seeking bobcats or other furbearers, or illegally trapped or shot by poachers. Prey species, such as snowshoe hares and ruffed grouse, may also be affected by legal and illegal trapping and shooting. To reduce or eliminate the incidence of illegal trapping and shooting of lynx, Minnesota Steel could work with the MNDNR and local conservation groups to initiate information and education efforts to protect the lynx and to ensure that trappers check their traps at frequent intervals and release lynx that are still alive. Trailhead posters, magazine articles, and news releases could be used to inform the public of the possible presence of lynx within or near the study area.

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