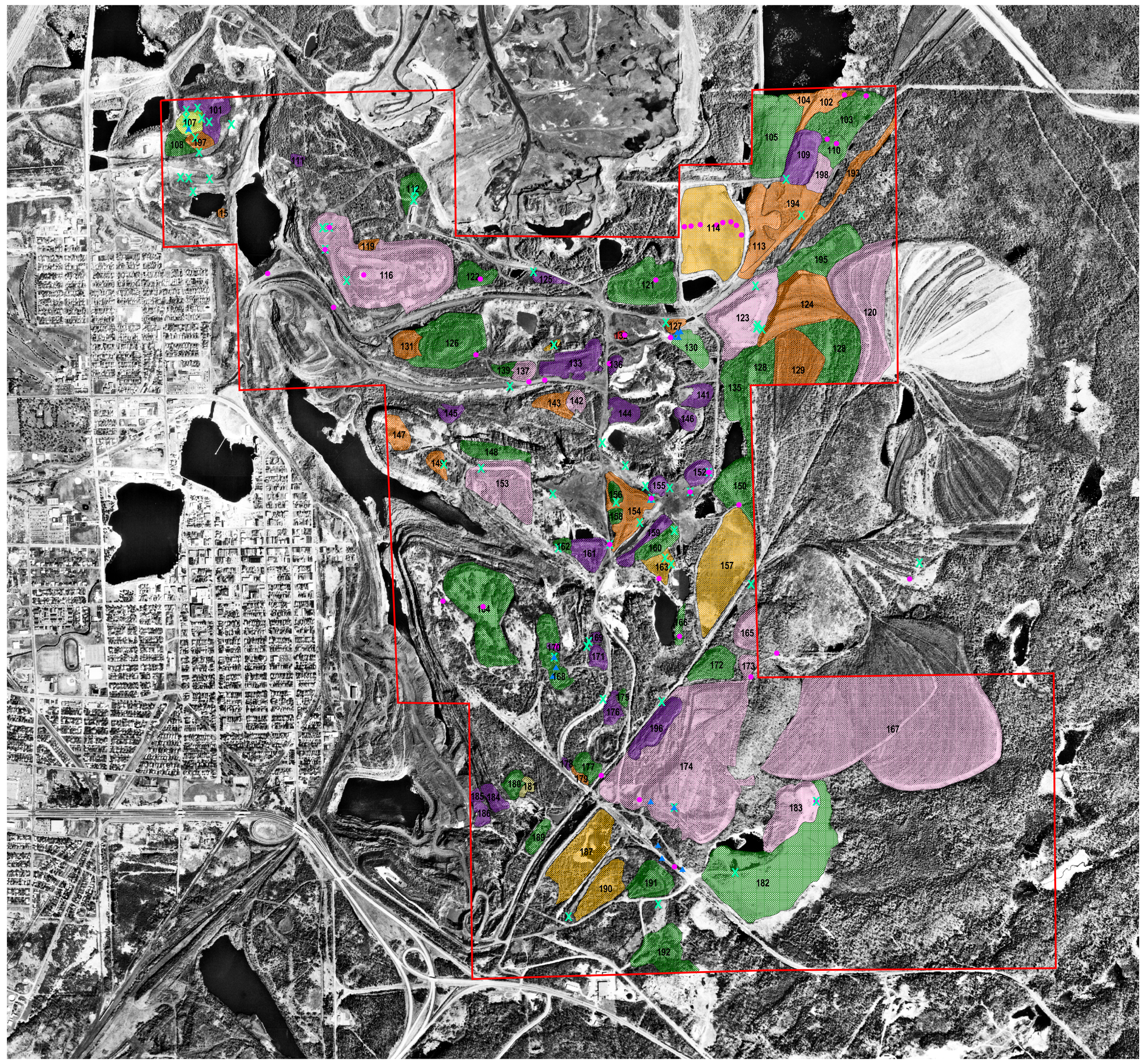
MATERIAL TYPE, VEGETATION, AND TRANSPORTATION VIRGINIA STUDY AREA

A PORTION OF TOWNSHIP 58 NORTH, RANGE 17 WEST ST. LOUIS COUNTY, MINNESOTA 2001



0.5 0 0.5 1 Miles

SITES VISITED DURING FIELD WORK

▲ Sample site • Observation site X Photo site

434 Stockpile identification number as referred to in the data

Plates III and IV contain information about stockpile material type, vegetation, and transportation. For the purposes of this project a stockpile is defined as earthen material transported in the process of mining. This includes tailing basins, overburden piles, ore dumps, and rock dumps. If the material had another intended use, such as a dike, overpass, or road base, then the material is not considered to be a stockpile. See Plate I for public land survey reference lines.

Stockpile Material Type

The stockpile classification system is based primarily on information gathered from mining companies and secondarily on information gathered in the field and by aerial photography interpretation. For stockpiles that rely solely on field observations to determine material type, it is important to note that only surface exposures of the stockpile could be accessed. Therefore, the descriptions and classifications of stockpile material is based upon what was observed at or near the stockpile surface. Due to this limitation, the continuity of a material type throughout a stockpile is unknown.

The classification system is based upon two factors: geology and mining processes. Geologic factors are physical characteristics that can be observed in both a natural outcrop and at the surface of a stockpile. These physical characteristics include mineralogy, texture, bedding, consolidation, grain size, grain shape, and other material specific qualities. Mining processes become a factor with iron ore stockpile material. Mining processes include further grinding and sorting of the bedrock for the purpose of iron unit extraction. In terms of a stockpile, factors that are attributed to mining processes are rock size, angularity, and sorting.

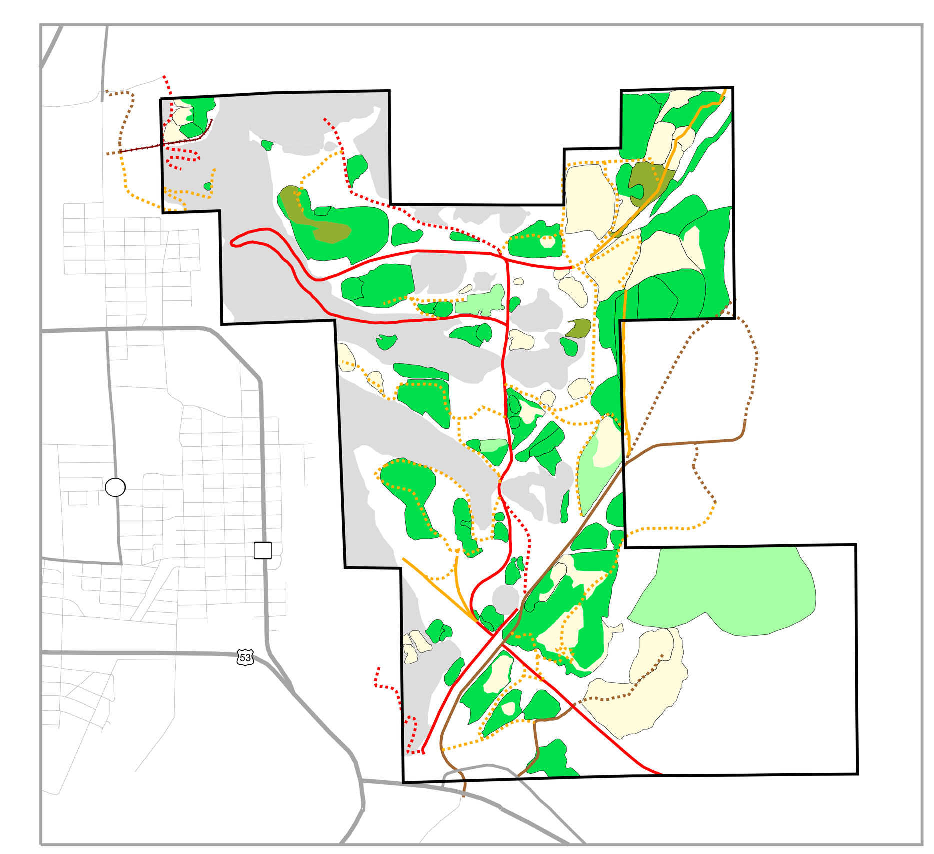
Field work was conducted in the fall of 1999 and in the summer of 2000. The majority of the stockpiles were visited and observed. Those not visited were inaccessible piles in open mining pits and piles with no road access. Field work consisted of observing, sampling, and photographing stockpiles within the study areas. The sample and photograph locations were captured by Global Positioning System (GPS). The observation point locations were gathered from both GPS and aerial photographs.

Vegetation

The vegetation was delineated on stockpiles to describe access and timber resources on individual piles. The vegetation survey was conducted by the interpretation of aerial photography (dated September 1995 for Calumet, and September 1997 for Virginia) and from field work conducted in the fall of 2000. Major forest vegetation cover types were determined to be aspen-birch (in order of prevalence: aspen, paper birch, and balsam poplar) and conifers (in order of prevalence: red pine, jack pine, balsam fir, white spruce, and white cedar). Generally, the aspen-birch cover type was naturally occurring; whereas, the majority of conifer types were plantation-planted red pine and jack pine. Size class determinations were based upon merchantability of the stand within a cover type. If the majority of trees in a stand with over a 50% canopy cover and an average diameter at breast height (dbh) greater than 5 inches, it was viewed as merchantable. Stands containing a majority of trees in the canopy with a dbh less than 5 inches were viewed as non-merchantable. Open areas were also delineated. These areas included barren ground, open water, grasslands, shrub or tree reproduction areas (less than 1 inch dbh), and any forest canopy with less than 50% cover.

Transportation

The transportation information consists of a combination of Minnesota Department of Transportation delineated roads and city streets, and Minnesota Department of Natural Resources delineated private mining roads. It is important to note that private mining roads are not for public transportation. Before a stockpile is mined, the surface owner should be contacted for permission to use these roads. The roads mapped as private mining roads are divided into two categories based on their condition: "good to moderate condition" and "poor to moderate condition." A private mining road in good to moderate condition is easily accessible and needs little modification. Private mining roads that are in poor to moderate condition may need to be re-graded, widened, or require other modifications to make the road suitable for accessing stockpiles. Private mining roads are further subdivided. If the road was at one time used as a railroad line, the road is noted as having a railroad grade. Old railroads were also mapped. Access to some of the stockpiles is restricted by the presence of berms or washouts, but these features were not mapped. Again, the surface owner should be contacted to gain access.



0.5 0 0.5 1 Miles

MATERIAL TYPE

Glacial Overburden: Unconsolidated sediment deposited by glaciers that was removed to gain access to the iron ore. Material consists of sediments deposited during the Quaternary Period (10,000 to 2 million years ago). The sediments range from till (material deposited directly by glacial ice) to sand and gravel (material deposited from glacial meltwater). Till is an unsorted sediment with grain sizes ranging from clay to +5 foot boulders. Multiple glacial advances deposited several till units in the region. In between some of these till units are discrete lenses of sand and gravel. In several overburden stockpiles, many of these various units are mixed together. The stockpiles tend to be boulder-rich with a sandy, silt matrix. The color ranges from buff to reddish-brown. Rock particles are sub-angular to sub-rounded. A few stockpiles contain primarily outwash sand and gravel. The sand and gravel is moderately sorted, oxidized to a light brown color, contains little silt, and is cobble-rich. The rock particles are sub-rounded. All glacial overburden stockpiles are considered to have high aggregate potential.

Cretaceous Overburden: Unconsolidated sediment in the form of saprolitic clay and rock particles that forms from highly weathered iron formation. Weathering events occurred during the Cretaceous period (65 to 146 million years ago). This material is dominantly clay with some rock particles. Within a given stockpile, cretaceous overburden may contain glacial till and other "overburden" type sediments. Cretaceous overburden has a low aggregate potential.

Natural Ore Mixed-Sized Rock: A soft ore that has been altered and re-mineralized along faults and fractures. This material was originally deposited as taconite, which was then oxidized in trough, fissure, or flat-lying ore bodies. The mineralogy consists of mostly hematite and limonite with minor amounts of magnetite and manganese oxides. There are a range of textures from compact to rubbly or friable. Bedding and other primary features are sometimes evident. Within a stockpile, this material is unsorted. Rock sizes range from clay to +6 foot boulders, with an average rock size being 3/8 inch to 5 inches. The amount of clay in natural ore piles is difficult to quantify; however, the clay seems to be a natural cement that stabilizes the stockpile. Natural ore rocks fracture, or part, parallel to bedding planes. Taconite boulders are frequently observed along the slopes of natural ore stockpiles and may have been placed there for slope and erosion control. Most natural ore piles have a moderate aggregate potential.

Natural Ore Coarse Tailings: A natural ore by-product of the iron extraction processes. This by-product contains mostly siliceous rocks with some hematite banding. The stockpiles are moderately-well sorted, ranging in size from 3/8 to 4 inches in diameter, with an angular particle shape. In the processing of coarse tailings, the material was washed; therefore, there is little to no silt within the pile. Most coarse tailings are considered to have a high aggregate potential.

Natural Ore Fine Tailings: A natural ore by-product of the iron extraction processes. Fine tailings have been crushed and are usually found deposited into a "tailings" basin. Grain sizes range from clay to 3/8 inch and are sub-angular rock fragments. Material is well sorted and has a moderate aggregate potential.

Paint Rock: A highly decomposed, slate-like rock with a tacky, powdery texture on exposed surfaces. The decomposition of these rocks are attributed to weathering of altered slate and natural ore along fault or joint planes. The descriptor, "paint", refers to the red to rust colored, colloidal particles that partially constitute the rock. Within stockpiles, paint rock can vary from fine sand to +3 feet rocks. Similar to natural ore, paint rock fractures parallel to bedding planes. Paint rock has low aggregate potential.

Taconite Rock Boulders: Magnetic and some non-magnetic iron ore. Characterized by alternating bands of iron oxides (magnetite and/or hematite) with bands of silicates and carbonates. Bedding and other primary structures are evident. Most taconite stockpiles consist of boulder sized rocks ranging from 2 feet to +9 feet diameter with an average of three feet. The boulders tend to have a blocky shape. Some glacial boulders may be incorporated into the pile. Taconite boulders have a moderate aggregate potential.

Taconite mixed-size rock: Magnetic and non-magnetic iron ore, some of which may have been processed. The rock characterization is described in "Taconite Rock Boulders" above. The stockpile type is difficult to discern from "Natural Ore Mixed-Size Rock" in the field and may contain other material within the stockpile; classification is based upon company records pertaining to individual stockpiles. These piles are poorly sorted, with a rock size from 2 mm to +6 feet. Taconite boulders frequently occur along the slope and edges of these piles. Taconite mixed-size rock piles have a moderate aggregate potential.

VEGETATION

- Aspen-Birch, 1-5 inch dbh - Aspen-Birch is major species component of forest canopy, with over 50% canopy cover and majority of trees over 1 inch, but less than 5 inches diameter at breast height (i.e., dbh). Generally considered non-merchantable.
- Aspen-Birch, >5 inch dbh - Aspen-birch is major species component of forest canopy, with over 50% canopy cover and majority of trees over 5 inches dbh. May be merchantable.
- Conifer, 1-5 inch dbh - Conifers (pine, spruce, balsam fir) are major species component of forest canopy; with over 50% canopy cover and majority of trees over 1 inch but less than 5 inches dbh. Generally considered non-merchantable.
- Conifer, >5 inch dbh - Conifers are major species component of forest canopy, with over 50% canopy cover and majority of trees over 5 inches dbh. May be merchantable.
- Open - barren, open water, grassland, shrub, or tree reproduction area (less than 1 inch dbh); or any forest canopy with less than 50% cover.

MINING ROADS

- Paved Road
- Unpaved Road
- Mining Road - good to moderate condition, railroad grade
- Mining Road - good to moderate condition, not a railroad grade
- Mining Road - poor to moderate condition, railroad grade
- Mining Road - poor to moderate condition, not a railroad grade
- Old Railroad

MAJOR ROADS

- US or MN Highway
- County or Township Road
- City Street

Funding for this project is from the Minnesota Legislature, ML 1999, Chapter 231, Section 16, Subdivision 7(k), as recommended by the Legislative Commission on Minnesota Resources.

Sources of base map information:
Digital Orthophoto Quad (DOQ) - US Geological Survey, based on quad-centered NAPP photography flown in 1991-1992.
Roads - State of Minnesota Basemap, Department of Transportation Surveying and Mapping BaseMap Development Group, 1998.