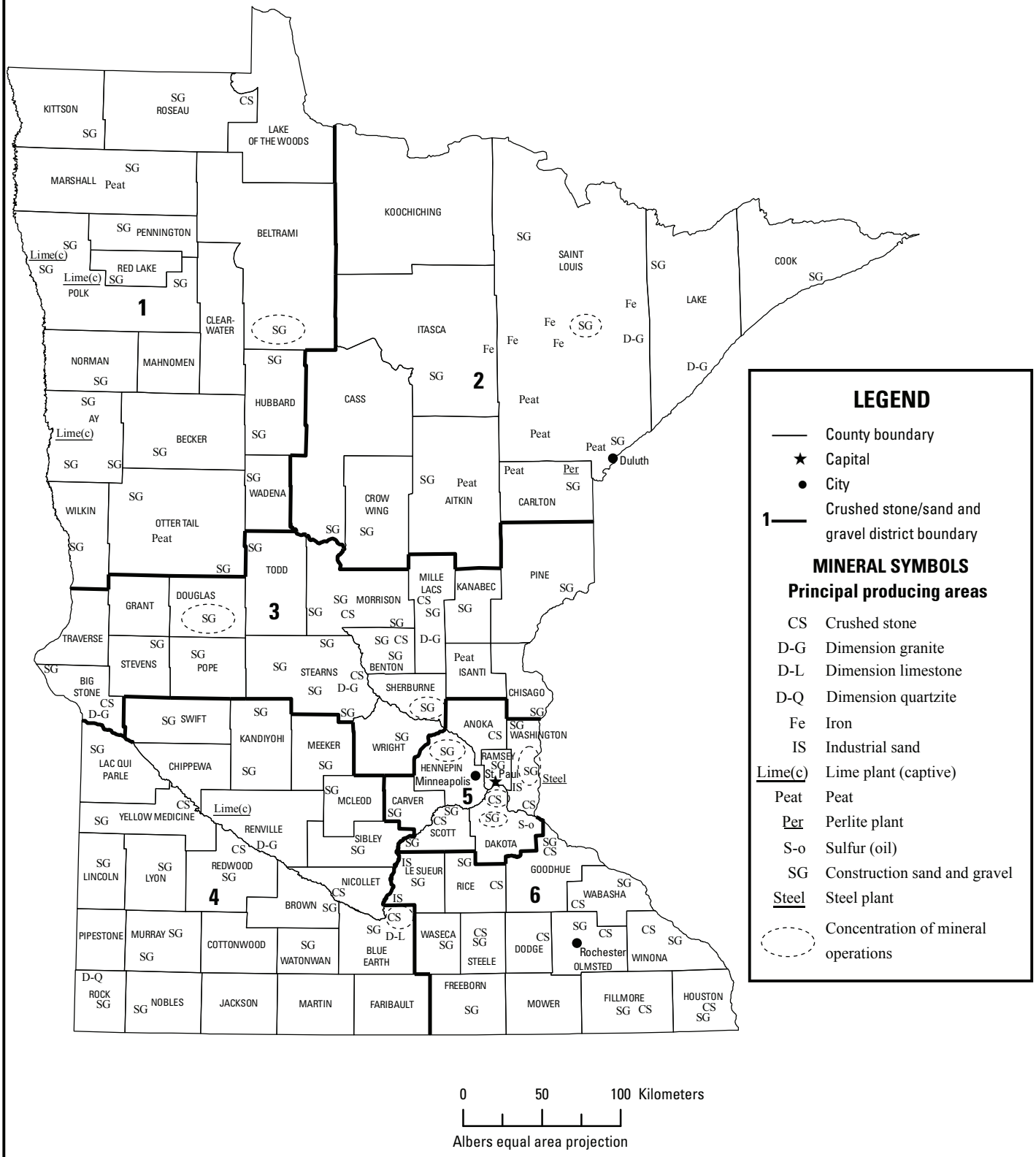
2009 Minerals Yearbook

MINNESOTA [ADVANCE RELEASE]

U.S. Department of the Interior
U.S. Geological Survey

March 2013

MINNESOTA



Source: Minnesota Department of Natural Resources, Division of Lands and Minerals/U.S. Geological Survey (2009).

The Mineral Industry Of Minnesota

In 2009, Minnesota's total nonfuel raw mineral production[1] was valued at $2.15 billion based upon annual U.S. Geological Survey (USGS) data. This was a $1.31 billion, or an almost 38%, decrease from the State's total nonfuel mineral value of $3.46 billion in 2008, which had increased by $670 million, or 24%, from a total of $2.79 billion in 2007. Minnesota declined in rank to eighth from seventh among the 50 States in total nonfuel mineral production value, and the State accounted for nearly 3.7% of the U.S. total, down from 4.8% in 2008.

Minnesota continued to be the Nation's leading iron ore-producing State in 2009, and based upon production value, iron ore continued to be the State's leading nonfuel mineral (actual production value data withheld—company proprietary data). In descending order of production value, the next top mineral commodities produced in the State were construction sand and gravel, crushed stone, industrial sand and gravel, and dimension stone. These five mineral commodities accounted for 99% of the State's total nonfuel mineral production value.

Decreases in total production value were seen with every mineral commodity produced in Minnesota in 2009, except gemstones. From 2001 to 2008, Minnesota saw annual increases in total nonfuel mineral production value. The decrease in total nonfuel raw mineral production value in 2009 was primarily the result of an almost 55% decline in the quantity of usable iron ore shipped (actual production values withheld—company proprietary data).

Other significant decreases in production value also took place in the value of construction sand and gravel and crushed stone, down $39 million and $12 million, respectively. By tonnage, both of these mineral commodities combined decreased by a total of 5.5 million metric tons (Mt). Among all States producing construction sand and gravel, Minnesota increased to seventh, up from ninth in 2008. Additionally, the State, which in 2008 and 2009 ranked second in peat production among 12 peat-producing States, saw that mineral commodity decrease in production value from $4.5 million to slightly more than $2.8 million, a decline of almost $1.7 million. The quantity of industrial sand and gravel produced in the State declined by 27% (actual value withheld—company proprietary data).

The following narrative information was provided by the Minnesota Department of Natural Resources' (MDNR)[2] Division of Lands and Minerals (DLM). Production data in the following text are those reported by the DLM, based upon its own surveys and estimates. The data may differ from some production figures reported by the USGS.

In 2009, mining in Minnesota continued in the nonfuel mineral sectors, and a variety of new mineral-related research and mineral exploration activities took place in the State. Identified resources of base metals, construction aggregates, dimension stone, direct-shipping grade iron ore, and peat allowed for prospective opportunities for new mineral development in the State. Geologically, Minnesota has potential for the occurrence of such mineral resources as base and precious metals, diamond, and kaolin. The level of investment in mineral exploration activity was significantly higher than in the past few years and many additional mineral development investment opportunities continued to exist in the State.

Exploration and Development

Industrial Minerals

Clays, Kaolin.—Acme Brick Co. drilled three exploratory auger holes for kaolin and industrial clay in the south-central portion of the State. Kennecott Exploration Co. holds industrial minerals leases at the Tamarack copper-nickel prospect in Aitkin County, roughly 16 km west of Cromwell. While drilling 17 exploratory holes in 2009, the company found kaolin within the 20 to 30 meters (m) of overburden that lies above the mineralized bedrock.

Stone, Dimension.—Cold Spring Granite Company removed test blocks from a new potential granite dimension stone quarry in St. Louis County about 80 km (50 miles) north of Duluth) and applied for a State industrial minerals lease.

Metals

Iron Ore.—Steel Dynamics, Inc. (Fort Wayne, IN), and Kobe Steel, Ltd. (Kobe, Japan), continued to partner in the construction and operation of the Mesabi Nugget plant in Hoyt Lakes, MN, the world's first full-scale commercial plant using the pioneering ITmk3 process developed by Kobe Steel (Kikuchi and others, 2010). The partners completed construction, which began in 2007, and began commissioning the $260 million plant, which has a 55-m (180-foot) diameter gas-fired rotary-hearth furnace (RHF). Through a chemical reduction process, the RHF is expected to yield millions of 96% to 98% iron nuggets. At full capacity, the plant is expected to produce 500,000 metric tons per year (t/yr) of iron nuggets. The announcement of the first production of iron nuggets from the facility was in early January 2010 (Steel Dynamics, 2010).

Essar Steel Minnesota, LLC (a subsidiary of Essar Steel Ltd., Hibbing, MN) broke ground at a site west of Nashwauk, MN, in September 2008 (Bily, 2008). In late 2009, Hammerlund Construction Inc. began excavation of the railroad corridor embankment, with additional plant foundation excavation work planned for 2010 (Hammerlund Construction Inc., 2012). The

[1] The terms "nonfuel mineral production" and related "values" encompass variations in meaning, depending upon the mineral products. Production may be measured by mine shipments, mineral commodity sales, or marketable production (including consumption by producers) as is applicable to the individual mineral commodity.

All 2009 USGS mineral production data published in this chapter are those available as of September 2011. All USGS Mineral Industry Surveys and USGS Minerals Yearbook chapters—mineral commodity, State, and country—can be retrieved over the Internet at URL http://minerals.usgs.gov/minerals.

[2] Donald Elsenheimer, Senior Planner, authored the text of information submitted by the Minnesota Department of Natural Resources.

company had access to significant iron ore resources, and it planned to build an integrated steel plant on the site with an annual capacity of 2.5 Mt upon completion of the estimated $1.65 billion project. The company's strategy included the development of a high-quality ore body, modern commercially proven processing technologies, and a vertically integrated steel mill. This will be the first facility in North America to include iron ore mining, ore processing, direct reduction of ore, and steelmaking at a single site.

Magnetation, Inc. (Grand Rapids, MN), formed in December 2006, began production of iron concentrate from its Mesabi Chief plant near Keewatin, MN. The plant was expected to produce low-cost iron concentrates at an estimated production rate of 300,000 t/yr from lean ore stockpiles. The company looked to expand to a production rate of 750,000 t/yr of concentrate to help feed Steel Dynamics' 500,000 t/yr Mesabi Nugget facility at Hoyt Lakes.

United States Steel Corp. (Pittsburgh, PA) drilled seven exploration holes outside their permit-to-mine area in 2009, in and near Section 16, near Leetonia, St. Louis County. Since this exploration took place outside the permitted mining area for iron ore, these holes are covered by the State's Exploratory Boring law. The law applies to all borings for metallic minerals, iron ore, and certain industrial minerals that are outside of active mine permit areas and allows MDNR to perform drill-site inspections to ensure regulatory compliance and requires the submission of drilling data to the MDNR.

Polymetallic Resources.—Seven companies continued metallic mineral exploration activities in 2009. Six companies focused exploration and development activity within the 1.1-billion-year-old Duluth Complex copper-nickel-platinum-group-metals deposits.

PolyMet Mining Corp. (Vancouver, British Columbia, Canada) planned to drill 132 exploratory borings for the 2009–10 winter to further define the NorthMet deposit ore body near Babbitt. The U.S. Army Corps of Engineers and MDNR released a draft Environmental Impact Statement for the NorthMet project in November, 2009 (MDNR, 2010a). Public information meetings were held on December 9, 2009, in Aurora, and December 10, 2009, in Blaine. Both agencies' comment periods were to end on February 3, 2010. The NorthMet Project would involve development of a new open pit mine and refurbishment and modification of the Cliffs Erie LLC taconite ore-processing facility near Hoyt Lakes, MN, to extract copper, nickel, and other precious metals.

Duluth Metals, Ltd. (Toronto, Ontario), worked to expand its Nokomis copper-nickel-platinum-group-metals deposit via step-out drilling, completing one exploratory boring. The company has drilled 156 exploratory borings since April 2006, with depths varying from approximately 430 to 1,400 m (1,400 to 4,500 feet). Duluth Metals updated its 2008 resource estimate with a Canadian National Instrument (NI) 43–101 Report and a NI 43–101-compliant preliminary assessment. The economic analysis was based on a conceptualized 40,000-metric-tons-per-day production rate from an underground mine.

Kennecott Exploration Co. drilled 17 holes in 2009 on their Tamarack project 80 km (50 miles) southwest of the Duluth Complex in Aitkin County. The Tamarack project consists of a high-grade copper-nickel prospect within a mafic-ultramfic intrusion. The company also explored additional nearby prospects in Aitkin and Carlton Counties.

Franconia Minerals Corp. (Spokane Valley, WA) completed a Canadian NI 43–101 compliant resource estimate for its Birch Lake property and continued to work on a mine waste characterization study. Teck Resources Ltd. (Vancouver, British Columbia, Canada) continued to work on a large assay program for its Mesaba copper-nickel sulfide deposit with existing core stored at the MDNR Drill Core Library in Hibbing. Encampment Minerals, LLC (Golden, CO), performed 13 exploratory borings on 3 separate prospects at various sites in the Duluth Complex.

One company, Vermillion Gold, LLC, drilled the first new exploratory gold borings in Minnesota in more than 13 years. Four exploratory borings were completed on two prospects, one of which was the Wawa Subprovince "Virginia Horn" prospect near Gilbert, southeast of Virginia, near the Mesabi Iron Range. Three areas of known gold mineralization in the Archean Superior Province greenstone belts were actively explored by mineral companies in 2009.

In total, five mineral companies completed a total of 42 exploratory borings under the State's Exploratory Boring law, with a total of more than 10,100 m (about 33,300 feet) of core obtained in 2009.

Commodity Review

Industrial Minerals

Peat.—Ten peat mining operations were covered under the permit-to-mine program in 2009. The peat mining operations included active harvesting, product research and development, and site reclamation. The majority of the peat produced in Minnesota was used in horticultural applications.

Aitkin Agri-Peat, Inc. leased about 445 hectares (ha) (1,100 acres) of State and county tax-forfeited lands east of Cromwell in Carlton County (about 56 km west of Duluth). The company was actively working almost 51 ha (125 acres) and produced more than 34,600 cubic meters (m^3) of sphagnum peat. On private land north of McGregor, Aitkin County, the company mined 97 ha (about 240 acres), producing about 26,300 m^3 of reed-sedge peat.

In the same vicinity, three other companies produced peat products. Premier Horticulture, Inc., leased about 202 ha (499 acres) of State and county tax-forfeited lands northwest of Cromwell. The company produced about 89,000 m^3 of spaghnum peat on approximately 125 ha (310 acres). The closure of the final 7 ha (17 acres) of its oldest mine area in 2009 brought its total area under active reclamation to 25 ha (63 acres). Sampson Farms, east of Aitkin in Aitkin County, mined on about 32 ha (78 acres) of privately held land with a production of almost 46,000 m^3 of brown moss (hypnum) peat.

A portion of this peat product was used in product development research for remediation of streams damaged by heavy metals. Thompson Farms, northeast of Aitkin, produced 1,150 m^3 of brown moss peat from approximately 0.4 ha (1 acre), though the company leased 32 ha (80 acres).

Conrad Fafard, Inc., operated on approximately 105 ha (260 acres) of State-leased land east of Floodwood, St. Louis County, producing just under 53,600 m^3 of sphagnum peat. Hawkes Company, Inc., located northeast of Newfolden in Marshall County, mined on about 87 ha (215 acres) of private and State-leased land, producing about 16,100 m^3 of reed-sedge peat. The total area in reclamation by the company in 2009 was almost 8 ha (19 acres); an additional 60 ha (149 acres) were previously reclaimed by the company and released from the Permit to Mine program. Northwoods Organics of Minnesota, LLC (formerly Waupaca Northwoods, LLC), operated on 115 ha (285 acres) of county tax-forfeited land south of Toivola in St. Louis County, producing about 81,800 m^3 of sphagnum peat.

Berger Horticultural Products, Ltd., leased 469 ha (1,160 acres) of State-owned peatland northwest of Big Falls in the Pine Island bog of west-central Koochiching County. No production occurred in 2009. Ferweda General Contracting leased about 65 ha (160 acres) of State-owned peatland northwest of Cotton, St. Louis County. No mining took place in 2009, though a limited amount of reed-sedge product was produced using peat stockpiled by the previous operator, and research continued into use of peat mixes as absorbents.

Sand, Industrial.—The application of silica sand used for the hydraulic fracturing process drove exploration for new resources, preparations for mine expansion, and development of processing plants in Minnesota. Known sources of silica sand were mined from the quartzose lithofacies of the Cambrian Jordan Sandstone, previously known as the Van Oser Member, which crops out in numerous places in counties bordering the Minnesota River, Mississippi River, and St. Croix River. Other potential sources of silica sand include the Ordovician St. Peter Sandstone and the Cambrian Wonewoc Sandstone. Similar to construction sand and gravel mining, permitting for industrial sand operations is done by local government authorities rather than the State government.

Sand and Gravel, Construction, and Crushed Stone.—Production of construction aggregate in Minnesota remained significantly lower than in previous years. Declining levels of aggregate production continue to reflect the slowdown in new residential and commercial construction. Construction aggregate is produced in every county and is mainly used in road maintenance and construction. Permitting of crushed stone quarries and sand and gravel operations is done by local governments.

Metals

Iron Ore.—Minnesota produced about 17.4 Mt of high-grade iron ore in 2009; nearly all of the final product shipped was in the form of pellets with small quantities of chips and concentrates. Iron ore mining in the State was conducted in open pit mines along the Biwabik Iron Formation, along the Mesabi Iron Range, although a minor amount of production came from reworked tailings. Nearly all of the iron ore shipped from Minnesota in 2009 was used in blast furnaces in the United States and Canada to make pig iron and then ultimately steel.

Iron ore production was down considerably from the 39.8 Mt produced in 2008 and was the lowest level of production in Minnesota since the Great Depression. The drop in production was owing to the global financial crisis. Although operations in Minnesota have produced iron ore from the Mesabi Range for more than 100 years and have seen cyclical production levels over time, in recent years, production was quickly curtailed when demand dropped.

Cliffs Natural Resources Inc. (Cleveland, OH) operates Hibbing Taconite Co., Northshore Mining Co., and United Taconite LLC. The company reported a total of about 8.7 Mt in pellet production in 2009, with Hibbing Taconite producing 1.7 Mt of standard pellets; Northshore Mining, about 3.1 Mt, including a small amount of sinter and concentrate; and, United Taconite Co., LLC, about 3.8 Mt, including a small amount of concentrates. The decrease in production at Hibbing Taconite started with the idling of two of three pellet lines in March, followed by a complete shutdown in May. The shutdown lasted until the first quarter of 2010. A plant shutdown from April through July at Northshore Mining led to a reduction of 2 Mt of Cliffs pellet production.

ArcelorMittal Minorca Mine Inc. (Chicago, IL) produced 1.4 Mt of flux pellets, including a minor amount of pellet chips, which was down from 2.6 Mt in 2008, because of a shutdown of operations between May and September.

In December 2008, U.S. Steel had already halted production at its Keewatin Taconite facility. This facility remained idled until late December 2009. U.S. Steel also announced plans to lay off 500 union employees, as well as 90 management employees, at its Minntac operations in early February. By August, rising demand for steel led the company to announce plans to start up one pellet production line at the Minntac plant and start an additional two lines in September, finishing the year with four of five production lines in operation. U.S. Steel, which had almost no production from its Keewatin Taconite operation in 2009, produced 7.2 Mt of flux pellets production from its Minntac operation.

Legislation and Government Programs

Permitting and Reclamation

Environmental Permitting, Review, and Reclamation.—MDNR is the responsible government agency for the environmental review of all proposed taconite, metallic mineral, and peat mining projects in Minnesota under the Minnesota Environmental Protection Act. It issues the permits to mine that establish and enforce mineland reclamation regulations at mining operations affecting over 101,000 ha (250,000 acres) of public and private lands.

Three ferrous-mining project proposals underwent MDNR environmental review and/or submitted permit to mine applications or amendments. This work involved the Mesabi Nugget plant and mine, the Keewatin Taconite plant and mine expansion, and Essar Steel Minnesota's proposed increased

mining rate and expanded furnace. In addition, a manganese extraction project near Emily, MN, was subject to environmental review. Cooperative Mineral Resources proposed collection of a bulk sample to test borehole mining of manganese from the Cuyuna Range banded iron formation.

Mineral Leasing and Royalties

The State of Minnesota owns and/or administers approximately 4.8 million ha (12 million acres) of mineral rights, and encourages environmentally sound mineral development that generates revenue for the State's citizens, schools, and counties. In 2009, mineral ownership title work was gathered by MDNR, focusing on priority areas near the Mesabi Range and other areas of the State that had nonferrous-metallic mineral potential. The Minnesota State Constitution provides MDNR with a fiduciary obligation to generate income for both the Permanent School (K–12) and Permanent University Trust Funds.

Mineral Leases.—MDNR issues and manages mineral leases and collects income from those leases. There were 123 iron ore leases in 2009, on more than 4,500 ha (more than 11,100 acres) of State land. From fiscal year (FY) 2006 to FY2009, taconite iron ore royalties provided about 95% of the State mineral income. In FY2009, active State metallic mineral exploration leases covered more than 48,100 ha (about 119,000 acres) of land, a 9% increase over the previous fiscal year.

Permanent University Trust Fund.—The Minnesota legislature created the Permanent University Trust Fund (PUTF) using mining royalties paid by taconite mining companies that mine on University Trust Land. The PUTF provides the University of Minnesota its largest endowed scholarship program. Over 20% of the University of Minnesota's new freshmen who are Minnesota residents receive an Iron Range Scholarship, with more than $2.12 million distributed in 2009. College scholarships funded from mining royalties from 1994 to 2009 totaled more than $16 million.

Permanent School Trust Fund and Mineral Potential Evaluations.—MDNR has a fiduciary responsibility to administer State mineral rights in the best interest of the Trusts that own them. As part of this responsibility, MDNR is the land administrator for the Permanent School Trust Fund and other Trust's lands and mineral rights, and completes mineral potential reviews on State land transactions. Mineral resource revenue from these Trust lands has contributed to more than 75% of the total revenue to Minnesota's Public School Trust over the last 100 years, operating as the primary revenue source.

Two projects were completed in 2009 to collect new data to identify lands with high mineral potential: a geochemical survey of gold-in-till samples and a review and assay of gold in historical drill cores.

As part of the geochemical survey, 48 till samples were collected in an area in northeastern Itasca County where the State has significant mineral holdings, but there is minimal exploration data (MDNR, 2011a). The samples were processed by a third-party independent contractor and the gold grains were counted by them. The results indicate that there are anomalously high gold grain counts in an approximately 7,800-ha (30-square-mile) area of an Archean Wawa Subprovince greenstone belt. The bedrock source of this gold is unknown.

In another project, historical drill cores were logged in an Archean Wabigoon Subprovince Greenstone belt in the International Falls area (MDNR, 2011b). It was noted that high gold content, at ore grade levels but short intervals, was found to be associated with base metals and disseminated sulfides, especially at the metamorphic transition between pyrite and pyrrhotite. MDNR has a portable x-ray fluorescence spectrometer to rapidly check the core for concentrations of gold and about 20 metals. This work was planned to continue into 2010. Some of the historical exploration data in this area, such as geophysical grids, drill hole locations, and geochemical survey sample locations, have been put into a GIS index.

Mineral Resources Research

Historical Exploration Data.—MDNR continued to enhance the usefulness and value of historical exploration data while reducing future costs to use the data. A large set of more than 6,500 lake- and stream-sediment exploration geochemical sample analyses were compiled to create one master digital data set (MDNR, 2010b). Drill-hole locations and collar information were compiled for 294 historic drill holes in Cass and Crow Wing Counties. Out of more than 16,300 drill holes listed in the State's multicounty dataset, 489 drill-hole records were updated. MDNR monthly data releases, aggregate resource maps, and many online documents pertaining to mineral research and exploration are available on the MDNR Web site (http://www.dnr.state.mn.us.). The MDNR Web site also hosts a public archive of more than 100 years of exploration data on State lands entitled "Public Access to Minerals Information" at http://minarchive.dnr.state.mn.us.

Natural Resources and Research Institute (NRRI).—Since 2000, NRRI has studied the application of taconite-mining byproducts to be used as high-quality construction aggregates. In a 2009 demonstration project, taconite obtained from Cliff Natural Resources' United Taconite mine was crushed by Laurentian Aggregate. Material was transported by rail to an articulated barge in Duluth Harbor (Zanko and Patelke, 2009). Roughly 4,500 t (5,000 short tons) was hauled 750 nautical miles to a harbor on the south shore of Chicago. This demonstration was in conjunction with ongoing research that evaluates the potential of what would otherwise be considered taconite waste rock as a high-quality aggregate. Final project results were slated for publication in 2010.

MDNR Construction Aggregate Resources Mapping Program.—In accordance with State Law (Minn. Statue 84.94), MDNR continued to produce construction aggregate resource maps and GIS datasets, as well as continued collaborative efforts with State agencies and local government to identify future aggregate resource supply issues. As of January 2010, work on 23 counties was completed, and two counties—Aitkin and Stearns—were in progress. A major report, compiled by MDNR, the Metropolitan Council, and the Minnesota Geological Survey, on the aggregate resources of the Seven-County Metropolitan Area, including the cities of Minneapolis

and St. Paul, was released in May 2009. An aggregate resource and geotechnical materials inventory near copper-nickel deposits was planned to begin in 2009. The project addresses an anticipated need for land-use planning associated with new mine development in portions of Lake and St. Louis Counties. Additionally, eight other counties via county board resolution requested construction aggregate resource maps with data.

Land-use restrictions due to conservation easements in addition to developmental pressures had been identified by MDNR as having the greatest impact to reduce the local availability of construction aggregate resources. MDNR reported that projected high population growth over the next 25 years could occur in rural counties of central Minnesota that currently have abundant supplies of high-quality construction aggregate. Conservation easements target large land tracts that can exceed almost 21,000 ha (80 square miles or 51,000 acres). MDNR collaborated with the Minnseota Department of Transportation, County Highway Engineers, and other interest groups to address the issue by proposing to prioritize the inventorying of construction aggregate for 12 key counties. Work will begin in 2010 with the mapping construction aggregate of Kanabec County and continued outreach to communities working on integrating aggregate resources in local land-use planning, to maintain future local supplies of aggregates.

Iron Ore Cooperative Research Program.—The Iron Ore Cooperative Research Program, created by the State legislature, was used to assist the Minnesota taconite industry by providing funds for taconite research projects. The program was appropriated $950,000 for 2008–09, which was matched by $475,000 in private grants from the taconite industry. A committee consisting of taconite mining company metallurgists, research scientists, and MDNR engineers determined the research priorities. The funded research projects were usually performed in Minnesota research laboratories and pilot-plant facilities. The program was considered very successful, with many of the funded research projects resulting in improved product quality and reduced production costs.

Minerals Coordinating Committee.—The Minerals Coordinating Committee (MCC) was established in 1987 by the State legislature as part of the minerals diversification plan. The MCC is composed of representatives from the minerals industry, labor, State agencies, and university research organizations. The committee was appropriated $350,000 for 2008–09 to fund mineral research projects. The goal is to fund research projects that increase the knowledge of the State's mineral potential, stimulate the development of mineral resources in the State, and promote basic mineral research. The program's success resulted in increased interest in exploration and development of Minnesota's copper-nickel resources by mining companies such as Duluth Metals, Twin Metals, Encampment Minerals, Franconia Minerals Co., Kennecott Minerals, PolyMet Mining, Prime Meridian Resources Corp., and Teck-Cominco Ltd. Funding from this program is also used to identify Minnesota aggregate resources, which aids county land-use planning agencies.

Environmental Research.—The State legislature established a Cooperative Environmental Research Fund to address environmental issues resulting from mining. The fund is administered by the MDNR, and $172,000 was appropriated for 2008–09. Research or demonstration projects are done in each of the State's mining sectors (ferrous, industrial minerals, and nonferrous), and projects require a match by non-State funds. The overall goal of the program is to develop and demonstrate new and cost-efficient reclamation techniques applicable to Minnesota's mining industry. Results and techniques developed from this program have been implemented by the mining industry to improve mine development and closure techniques, to improve reclamation procedures, and to control environmental impacts. Research in 2009 focused on mercury control technologies at taconite processing plants.

References Cited

Bily, Beth, 2008, Essar Steel breaks ground for slab mill on Iron Range: BusinessNorth [Duluth, MN], September 19. (Accessed February 6, 2013, at http://www.businessnorth.com/briefing.asp?RID=2670.)

Kikuchi, S., Ito, S., Kobayashi, I., Tsuge, O., and Tokuda, K., 2010, Kobelco Technology Review: Kobe Steel, no. 29, December, 8 p. (Accessed April 11, 2012, at http://www.kobelco.co.jp/english/ktr/pdf/ktr_29/077-084.pdf.)

Hammerlund Construction Inc., 2012, Hammerlund Civil Construction MN – Essar Steel Minnesota, LLC: Grand Rapids, MN, Hammerlund Construction Inc. (Accessed February 6, 2013, at http://www.hammerlundconstruction.com/civil-construction/essar-project.)

Minnesota Department of Natural Resources (MDNR), 2010a, PolyMet Mining Inc./NorthMet project: Saint Paul, MN, Minnesota Department of Natural Resources. (Accessed April 11, 2012, at http://www.dnr.state.mn.us/input/environmentalreview/polymet/index.html.)

Minnesota Department of Natural Resources (MDNR), 2010b, Minnesota Lake Sediment Geochemistry Surveys: Saint Paul, MN, Minnesota Department of Natural Resources Report 376. (Accessed April 11, 2012, at http://www.dnr.state.mn.us/lands_minerals/mpes_projects/report376.html.)

Minnesota Department of Natural Resources (MDNR), 2011a, Regional survey of gold in till, Archean greenstone belt, northeastern Itasca County: Saint Paul, MN, Minnesota Department of Natural Resources Open-File Project 379. (Accessed April 11, 2012, at http://www.dnr.state.mn.us/lands_minerals/mpes_projects/project379.html.)

Minnesota Department of Natural Resources (MDNR), 2011b, Koochiching County Archean greenstone drill core assays: Saint Paul, MN, Minnesota Department of Natural Resources Open-File Project 379. (Accessed April 11, 2012, at http://www.dnr.state.mn.us/lands_minerals/mpes_projects/project379.html.)

Steel Dynamics Inc., 2010, Steel Dynamics announces first production of Mesabi nuggets: Fort Wayne, IN, Steel Dynamics Inc. press release, January 13. (Accessed April 11, 2012, at http://www.steeldynamics.com/steel-dynamics-announces-first-production-of-mesabi-nuggets/.)

Zanko, L.M., and Patelke, M.M., 2009, Taconite aggregate—crushed rock—Laurentian aggregate transportation of material by barge to Chicago, Illinois: Duluth, MN, Natural Resources Research Institute, August, 23 p. (Accessed April 11, 2012, at http://www.nrri.umn.edu/egg/REPORTS/TSR200903/NRRITSR200903.pdf.)

TABLE 1

NONFUEL RAW MINERAL PRODUCTION IN MINNESOTA[1, 2]

(Thousand metric tons and thousand dollars)

Mineral	2007		2008		2009	
	Quantity	Value	Quantity	Value	Quantity	Value
Gemstones, natural	NA	6	NA	7	NA	7
Iron ore, usable shipped	38,800	W	41,100	W	18,700	W
Peat	41	4,350	48	4,540	44	2,850
Sand and gravel, construction	47,000 r	242,000 r	34,700 r	227,000 r	30,800	188,000
Stone:						
Crushed	10,400	111,000	10,300 r	122,000 r	8,670	110,000
Dimension	28	14,400	31	17,200	25	16,700
Combined values of clays [common (2007–08)], lime, sand and gravel (industrial), and values indicated by symbol W	XX	2,410,000	XX	3,090,000	XX	1,830,000
Total	XX	2,790,000 r	XX	3,460,000 r	XX	2,150,000

[r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

TABLE 2

MINNESOTA: CRUSHED STONE SOLD OR USED, BY TYPE[1]

Type	2008			2009		
	Number of quarries	Quantity (thousand metric tons)	Value (thousands)	Number of quarries	Quantity (thousand metric tons)	Value (thousands)
Limestone[2]	46 r	2,990 r	$33,400 r	39	2,720	$33,200
Dolomite	4	2,130	27,300	3	1,600	22,400
Granite	7	3,010	31,500	7	2,640	32,400
Sandstone and quartzite	3	2,110	28,600	3	1,570	21,000
Miscellaneous stone	4 r	97 r	785 r	8	131	1,330
Total	XX	10,300 r	122,000 r	XX	8,670	110,000

[r]Revised. XX Not applicable.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes limestone-dolomite reported with no distinction between the two.

TABLE 3
MINNESOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS
IN 2009, BY USE[1]

(Thousand metric tons and thousand dollars)

Use	Quantity	Value
Construction:		
Coarse aggregate (+1½ inch):		
Riprap and jetty stone	35	860
Filter stone	W	W
Other coarse aggregate	68	1,300
Coarse aggregate, graded:		
Concrete aggregate, coarse	W	W
Bituminous aggregate, coarse	W	W
Bituminous surface-treatment aggregate	W	W
Railroad ballast	W	W
Other graded coarse aggregate	635	11,800
Fine aggregate (-⅜ inch):		
Stone sand, concrete	W	W
Stone sand, bituminous mix or seal	W	W
Screening, undesignated	W	W
Other fine aggregate	260	3,500
Coarse and fine aggregates:		
Graded road base or subbase	388	3,920
Unpaved road surfacing	W	W
Terrazzo and exposed aggregate	W	W
Crusher run or fill or waste	W	W
Other coarse and fine aggregates	419	4,260
Other construction materials	9	85
Agricultural:		
Limestone	W	W
Poultry grit and mineral food	W	W
Other miscellaneous uses and specified uses not listed	1,320	18,200
Unspecified:[2]		
Reported	3,660	44,600
Estimated	1,290	15,300
Total	8,670	110,000

W Withheld to avoid disclosing company proprietary data; included in "Total."

[1]Data are rounded to no more than three significant digits

[2]Reported and estimated production without a breakdown by end use.

TABLE 4

MINNESOTA: CRUSHED STONE SOLD OR USED BY PRODUCERS IN 2009, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3		District 4	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Construction:								
Coarse aggregate (+1½ inch)[2]	--	--	--	--	W	W	W	W
Coarse aggregate, graded[3]	--	--	--	--	W	W	W	W
Fine aggregate (-⅜ inch)[4]	--	--	--	--	W	W	W	W
Coarse and fine aggregates[5]	--	--	--	--	W	W	W	W
Other construction materials	--	--	--	--	--	--	--	--
Agricultural[6]	--	--	--	--	--	--	W	W
Other miscellaneous uses	--	--	--	--	--	--	--	--
Unspecified:[7]								
Reported	--	--	--	--	1,220	14,900	1,710	21,000
Estimated	13	164	4	51	291	3,580	--	--
Total	13	164	4	51	1,660	20,100	2,080	25,200

	District 5		District 6		Unspecified districts	
	Quantity	Value	Quantity	Value	Quantity	Value
Construction:						
Coarse aggregate (+1½ inch)[2]	W	W	--	--	--	--
Coarse aggregate, graded[3]	W	W	--	--	--	--
Fine aggregate (-⅜ inch)[4]	W	W	--	--	--	--
Coarse and fine aggregates[5]	W	W	--	--	--	--
Other construction materials	9	85	--	--	--	--
Agricultural[6]	W	W	--	--	--	--
Other miscellaneous uses	--	--	1,320	18,200	--	--
Unspecified:[7]						
Reported	395	4,500	287	3,560	57	644
Estimated	40	496	753	9,210	185	1,810
Total	2,300	31,300	2,360	31,000	242	2,450

W Withheld to avoid disclosing company proprietary data; included in "Total." -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes filter stone, riprap and jetty stone, and other coarse aggregate.

[3]Includes bituminous aggregate (coarse), bituminous surface-treatment aggregate, concrete aggregate (coarse), railroad ballast, and other graded coarse aggregate.

[4]Includes screening (undesignated), stone sand (concrete), stone sand (bituminous mix or seal), and other fine aggregate.

[5]Includes crusher run or fill or waste, graded road base or subbase, unpaved road surfacing, terrazzo and exposed aggregate, and other coarse and fine aggregates.

[6]Includes limestone and poultry grit and mineral food.

[7]Reported and estimated production without a breakdown by end use.

TABLE 5
MINNESOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2009,
BY MAJOR USE CATEGORY[1]

Use	Quantity (thousand metric tons)	Value (thousands)	Unit value
Concrete aggregate (including concrete sand)	3,410	$23,200	$6.80
Plaster and gunite sands	184	1,410	7.68
Concrete products (blocks, bricks, pipe, decorative, etc.)	95	943	9.93
Asphaltic concrete aggregates and other bituminous mixtures	1,420	14,900	10.49
Road base and coverings	4,570	14,700	3.22
Road stabilization (cement)	33	216	6.55
Road stabilization (lime)	53	457	8.62
Fill	1,100	4,350	3.96
Snow and ice control	68	419	6.16
Roofing granules	86	1,260	14.60
Other miscellaneous uses[2]	105	1,080	10.30
Unspecified:[3]			
Reported	6,160	53,100	8.62
Estimated	13,500	71,600	5.31
Total or average	30,800	188,000	6.10

[1]Data are rounded to no more than three significant digits, except unit value; may not add to totals shown.

[2]Includes filtration, golf course, and railroad ballast.

[3]Reported and estimated production without a breakdown by end use.

TABLE 6

MINNESOTA: CONSTRUCTION SAND AND GRAVEL SOLD OR USED IN 2009, BY USE AND DISTRICT[1]

(Thousand metric tons and thousand dollars)

Use	District 1		District 2		District 3	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products[2]	1,230	9,430	608	3,710	821	4,900
Asphaltic concrete aggregates and road base materials[3]	1,330	5,690	159	774	1,680	4,790
Fill	256	771	47	245	170	472
Snow and ice control	9	38	7	60	14	80
Roofing granules	--	--	--	--	86	1,260
Other miscellaneous uses[4]	4	31	--	--	73	821
Unspecified:[5]						
Reported	1,440	11,700	217	488	721	11,200
Estimated	2,380	13,600	2,380	13,400	4,400	19,900
Total	6,640	41,300	3,420	18,700	7,970	43,400

	District 4		District 5		District 6	
	Quantity	Value	Quantity	Value	Quantity	Value
Concrete aggregate and concrete products[2]	435	2,930	285	2,340	63	596
Asphaltic concrete aggregates and road base materials[3]	1,090	10,400	W	W	W	W
Fill	135	419	419	2,250	73	193
Snow and ice control	3	21	W	W	W	W
Roofing granules	--	--	--	--	--	--
Other miscellaneous uses[4]	15	106	539	5,130	231	1,460
Unspecified:[5]						
Reported	398	2,250	1,280	13,400	502	2,550
Estimated	1,250	7,210	1,730	9,900	1,340	7,530
Total	3,320	23,300	4,250	33,100	2,210	12,300

	Unspecified districts	
	Quantity	Value
Concrete aggregate and concrete products[2]	245	1,660
Plaster and gunite sands	--	--
Asphaltic concrete aggregates and road base materials[3]	1,100	2,390
Fill	--	--
Snow and ice control	--	--
Roofing granules	--	--
Other miscellaneous uses[4]	--	--
Unspecified:[5]		
Reported	1,610	11,600
Estimated	--	--
Total	2,960	15,600

W Withheld to avoid disclosing company proprietary data; included in "Other miscellaneous uses." -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes plaster and gunite sands.

[3]Includes road and other stabilization (cement and lime).

[4]Includes filtration, golf course, and railroad ballast.

[5]Reported and estimated production without a breakdown by end use.