THE BRIEFING

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THE WATER

In late August, when the rice is ready, the harvesters go out in canoes.

Minnesota law says the canoe cannot be longer than 18 feet or wider than 36 inches. No motor. A forked push pole — forks no longer than 12 inches — to move between the stalks without breaking them. Two smooth wooden sticks, called knockers. No longer than 30 inches. No heavier than one pound.

The harvester bends the stalks over the gunwale with one knocker and taps the ripe grain loose with the other. The kernels fall into the hull. Most of the grain — 85 to 90 percent — falls back into the water. Wild rice is an annual grass. If it does not reseed itself, there is no harvest the next year. The law exists because the plant's survival matters more than this season's yield.

From the canoe, the water is clear enough to see the bottom at 15 feet. Common loons call across the lake — a sound that carries for miles when there is nothing else to carry. White pine along the shore. Moose at the water's edge at dawn. No roads. No cell towers. No motors on most of the lakes. Between the loon calls, the sound is wind through the pines and the hull of the canoe passing through rice.

The Ojibwe call wild rice *manoomin* — the good berry. They migrated to this place from the Atlantic coast, following a prophecy to find the food that grows on water. They have harvested it here for centuries. It is mandatory in their ceremonies — weddings, funerals, naming rites.

In 1939, the Minnesota Legislature declared a state of emergency after commercial harvesters brought paddle-wheel machines that stripped the beds bare and destroyed them for future years. The legislature codified the traditional methods — the canoe, the knockers, the forked pole, the hours and the season — into state law. The regulations are not restrictions on the harvest. They are the harvest, preserved.

The Boundary Waters Canoe Area Wilderness covers 1.1 million acres of northeastern Minnesota. It contains more than 1,100 lakes. The Superior National Forest that surrounds it holds 20 percent of all the fresh water in the entire National Forest System — one-fifth of the fresh water in every national forest in America, in one place. About 150,000 people visit every year. It is the most-visited wilderness area in the United States.

The rock underneath is 1.1 billion years old. It is called the Duluth Complex, and it contains copper, nickel, cobalt, and platinum group metals locked inside sulfide ore.

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The town nearest the proposed mine site is Ely, population 3,300. Forty years ago, it was larger. The population has fallen 30%.

Ely calls itself the Canoe Capital of the World. Twenty-two professional outfitters operate there. Thirty-seven resorts and lodges. Fifteen motels. Across the broader Arrowhead region, tourism supports roughly 17,000 jobs and generates between $900 million and $1 billion in annual economic activity.

Tourism jobs pay $15 to $20 an hour. Most are seasonal. Most do not include health insurance.

Mining jobs pay $90,000 a year with full benefits. Pensions. Year-round work.

Ely is divided. The division is described by residents as toxic. In late 2023, a chapter of Braver Angels — a national depolarization organization — was formed to address the community's deep divisions, principally over mining. At a January 2025 forum, 100 residents attended. Both sides agreed on two things: the town is losing population, and there are not enough jobs that pay enough to stay.

Bill Erzar, a retired steelworker, said: "I think providing jobs in this community is what we need to do and if we can do this properly, I think copper-nickel is the way of the future."

Gerald Tyler, a retired businessman who founded Up North Jobs, said: "We love tourism. But you can't depend upon the job, especially if you're a single parent, to provide enough to educate your children, to provide health care, because very few of the tourism jobs provide health care."

Sean Leary, an environmental scientist who co-owns an outfitting company in Ely, said: "I'm not anti-mining. But copper-nickel mining has a 100% track record polluting the environment."

These are people watching their town disappear. The median age rises. The school enrollment falls. The young leave for the Twin Cities and do not come back. When someone offers 750 jobs at $90,000 with health insurance, the arithmetic is simple.

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The company offering those jobs estimates the mine would last 25 years. That estimate comes from its own 2019 mine plan and has not been independently validated. The closest comparable mine in the United States — Eagle Mine in Michigan, also a high--grade copper-nickel sulfide operation — was projected to last 8 years. It has been extended to approximately 13 to 16 through successive discoveries of adjacent ore bodies, each smaller and

more marginal.

The 750-job figure is the peak operational headcount. It does not include the 3-to-7-year ramp-up when employment is lower, or the wind-down when the workforce shrinks section by section. PolyMet — the other proposed copper-nickel mine in Minnesota — projected that only 25% of permanent hires would come from the local community. The specialized skills required for sulfide mining do not exist in a workforce trained for iron ore. Even in Chile, where the company behind Twin Metals has operated for decades, only 48% of the direct workforce is local.

Copper and nickel are components of electric vehicle batteries, wind turbines, and solar panels. The minerals are real, and domestic supply matters. But the United States currently has two copper smelters, zero nickel smelters, and zero cobalt smelters. The last new copper smelter was built in 1976. The only nickel smelter in the country's history closed in 1998. Antofagasta has acknowledged the minerals extracted in Minnesota would likely require processing overseas — primarily in China. Under the General Mining Act of 1872, there is no legal requirement to process the minerals domestically or to keep them in the country. No legislation has been introduced to require domestic processing as a condition of the lease.

When Butte, Montana, was offered the same promise — jobs, prosperity, a future — the town embraced it. At its peak, Butte's population reached 100,000. Today it is approximately 34,000. Eighteen to 20% live below the poverty line. Twenty percent are food insecure. The treatment plant for the water the mine left behind will operate forever. The mining company is gone. The taxpayer pays. Butte operated before modern environmental law. Eagle Mine in Michigan operates under the current framework.

A peer-reviewed study by Harvard economists James Stock and Jacob Bradt — Stock is a former chair of the Harvard Economics Department and a former member of the Council of Economic

Advisers — was published in *Ecological Economics* in 2020. The study was commissioned by conservation groups. It modeled 72 scenarios over 20 years. In 69 of them, the region produced more jobs and more income without the mine. The mechanism: mining inflates local wages and costs during the boom, which suppresses the tourism and recreation economy that depends on the wilderness. When the mine closes, both the mining jobs and the amenity-driven jobs are gone. The study excluded declining property values and cleanup costs from its model.

Independent sportsmen's and conservation groups that oppose the mine — Backcountry Hunters & Anglers, Theodore Roosevelt Conservation Partnership, Sportsmen for the Boundary Waters — have cited these findings. A 2017 poll by the Trump-aligned firm Fabrizio Ward found 66% of Minnesota Republicans supported a 2-year mining pause to study the impacts.

A $270,000 media campaign by the Center of the American Experiment, a Minnesota-based industry-aligned think tank, promoted an alternative analysis arguing that mining wages are higher and that mining and tourism can coexist. That analysis did not model the bust phase or the long-term displacement of other industries.

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The company proposing the mine is Twin Metals Minnesota. It is a wholly owned subsidiary of Antofagasta PLC, a mining conglomerate listed on the London Stock Exchange and controlled by the Luksic family of Chile. The family holds 60.66% of ordinary shares and 94.12% of super-voting preference shares. Their fortune is estimated at over $33 billion.

Antofagasta's 2025 revenue was $8.62 billion. It paid approximately $386 million in dividends to the Luksic family in one year. All four of the company's active mines are in Chile. In 2024, over 99% of its government tax payments went to Chile.

The company that would operate the mine has never operated a mine in the United States. Its operations in Chile have been fined for water management violations, for illegal extraction of nearly 1 million cubic meters of water during extreme scarcity, and for pipeline breaks that contaminated agricultural land. At its El Mauro tailings dam site, according to Chilean regulatory records, the company destroyed over 500 boulders containing pre-Columbian petroglyphs. In 2024, it filed lawsuits against 32 local residents who were protesting.

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Sulfide-ore mining is not iron mining. Minnesota has mined iron for over a century. Iron ore does not produce acid when it meets water. Sulfide ore does.

When sulfide rock is exposed to air and water, it oxidizes to form sulfuric acid. The acid dissolves copper, arsenic, mercury, lead, and cadmium into the water table. The reaction is self-sustaining. Microorganisms in the soil accelerate it by a factor of up to 100,000. Once it starts, it does not stop.

A 2012 Earthworks study examined 14 major U.S. copper sulfide mines. All 14 had experienced spills or accidental releases. A 2006 study of 25 modern hardrock mines found that all 25 exceeded water quality standards, despite predicting they would not. A 2025 study of 8 mines permitted since 1990 found that all 8 degraded downstream water quality.

From 1998 to 2017, Wisconsin maintained a law called "Prove It First." The law required any company proposing a sulfide mine to provide a single example of a comparable mine anywhere in the world that had operated for 10 years and been closed for 10 years without polluting surrounding water. In 19 years, no mining company on Earth could meet the standard. The law was repealed.

The Boundary Waters' geology makes contamination more likely, not less. The rock lacks the buffering minerals that neutralize acid in other formations. The water flows north — from the mine site into the heart of the wilderness, onward through Voyageurs National Park, down the Rainy River, and into Lake of the Woods near Baudette. The watershed covers roughly 370 miles. Sulfate from mining does not dissipate in open waterways. It travels the full distance. At the downstream end, it stimulates bacteria in peatlands and lake sediments that convert atmospheric mercury into methylmercury — a neurotoxin that accumulates through the food chain, from plankton to small fish to walleye to the people who eat them. Fish in some Boundary Waters lakes already carry mercury levels 3 to 7 times the safe consumption threshold.

The watershed crosses into Manitoba. The International Joint Commission manages it. A mine in Minnesota could contaminate Canadian water.

The U.S. Forest Service's own Environmental Assessment concluded that contamination from sulfide-ore mining in the Rainy River Watershed could persist "for centuries or longer" and cause irreversible harm to the ecosystem.

At Rio Tinto in Spain, acid mine drainage has flowed continuously from Roman-era galleries for 2,000 years. At Iron Mountain in California, the remaining sulfide will produce acid for 2,500 to 3,000 more years. The treatment plant there must operate in perpetuity. At the Berkeley Pit in Butte — the same town that was promised prosperity — 30 to 50 billion gallons of toxic water sit in the open pit. In November 2016, between 3,000 and 4,000 snow geese died in a single night after landing on the water during a snowstorm.

The companies that created these sites did not outlast the damage. At Summitville in Colorado, the operator posted a $4.5 million bond and declared bankruptcy. Cleanup has cost taxpayers

over $200 million.

Eagle Mine in Michigan — the closest operating precedent to what is proposed for Minnesota — reports 100 documented exceedances of groundwater benchmarks since it opened. Uranium has been detected at more than 3 times the EPA's safe drinking water standard. The mine maintains a record of "zero violations" because its permits were amended to raise the thresholds when pollutant levels rose.

The geology of the Duluth Complex, the chemistry of acid mine drainage, domestic mineral alternatives, and emerging extraction technologies are documented in the companion reference, The Deposit.

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In October 2017, Tom Emmer introduced H.R. 3905, the MINER Act. The bill would mandate Twin Metals' lease renewals, require an act of Congress for any future mineral withdrawal in the area, and replace the full Environmental Impact Statement with a 30-day assessment. It passed the House 216 to 204. It died in the Senate. He framed it as a question of national security, arguing the country must "decrease our reliance on foreign countries like Russia and China" for critical minerals.

In the same year Emmer was building the legislative architecture, the law firm WilmerHale was lobbying the Department of the Interior on behalf of Twin Metals. WilmerHale was also, simultaneously, representing Ivanka Trump and Jared Kushner on ethics compliance — the Kushners were renting a Washington mansion owned by the Luksic family through a shell company. Both engagements ran concurrently through the same firm throughout 2017. No evidence connects Emmer to the WilmerHale arrangement or the Kushner rental.

On December 22, 2017, the Interior Department's Principal Deputy Solicitor issued a memo reversing the Obama-era legal opinion and clearing the way for Twin Metals' lease renewal.

FOIA records indicate the memo closely tracked a legal analysis WilmerHale had drafted the previous year. WilmerHale's ethics representation of the Kushners ended on December 31, 2017 — the same month.

Antofagasta cannot legally donate to American political campaigns. It spent $9 to $10 million in lobbying instead. It retained a former Interior Secretary, a former Minnesota Senate Majority Leader who registered as its lobbyist less than a month after leaving office, and a former U.S. Senate Majority Leader. Both parties' former leaders. One mining company.

In January 2026, Emmer — now House Majority Whip — whipped H.J. Res. 140 through the House. "This is not your grandfather's mine, this is not your father's mine," he said. "This is mining in the 21st century, which is safe, it protects the environment, but it gives us access to the critical minerals that we're going to need to move this country forward into the future."

The argument refers to specific technologies: underground extraction instead of open-pit, dry-stack tailings instead of wet impoundments behind earthen dams, advanced water treatment, real-time groundwater monitoring. The designs are real. Dry-stack tailings have not been tested in Minnesota's climate — where winter temperatures reach 30 to 40 below zero, spring melt saturates the ground, and the freeze-thaw cycle stresses containment infrastructure that must function without failure for centuries. Every study of mines built under the current regulatory framework — 14 of 14, 25 of 25, 8 of 8 — found contamination.

The vote was 214 to 208. The architecture he began building in 2017 was complete.

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In 2011, a drilling crew working for Franconia Minerals — a company later absorbed by Twin Metals — punched into the Duluth Complex near Babbitt, looking for copper and nickel. In borehole

LOD-6, they found something else. Helium. At a concentration of 14.5%.

The industry standard for an economically viable helium well is 0.3%. This was nearly 50 times that threshold. The concentration has been verified by the U.S. Geological Survey, Lawrence Livermore National Laboratory, the Woods Hole Oceanographic Institution, and the University of Toronto. They also found helium-3 — valued at approximately $18.5 million per kilogram, used in quantum computing and nuclear fusion research.

The company logged the discovery. They did not pursue it. They continued drilling for copper.

Pulsar Helium eventually secured the rights. Their Topaz project sits 12 miles from the Boundary Waters border — further than the proposed copper mine at 2 to 5 miles. The wells flow naturally under pressure. No hydraulic fracturing is required. The footprint is comparable to a gas station. The Minnesota DNR estimates the project could generate up to $1 million per day in revenue at full production. No acid mine drainage. No tailings dams. No perpetual water treatment. No threat to the watershed.

Helium is non-substitutable. There is no alternative material for cooling MRI magnets, for manufacturing semiconductor chips, for pressurizing rocket fuel systems, for cooling quantum computers. Copper can be partially replaced by aluminum. Helium cannot be replaced by anything.

The United States Federal Helium Reserve — established in 1925 for military use, maintained for a century as a strategic safety net — was sold in June 2024. Congress mandated the sale through the Helium Stewardship Act of 2013, requiring the Bureau of Land Management to dispose of all assets. A German company, Messer, bought the entire system — the reservoir, the gas plant, the 423-mile pipeline — for approximately $460 million. The reserve was projected for exhaustion by September 2027, before one-third of global helium supply was knocked offline by strikes

on Qatar's Ras Laffan complex in March 2026. The timeline is now shorter. Hospitals are facing 50% cuts to MRI refill deliveries. Semiconductor production lines that supply the chips in American weapons systems depend on helium — and the reserve is gone.

Neither Tom Emmer nor Pete Stauber has made helium a signature legislative issue. No bill. No floor speech. No appropriations amendment. All of the political capital — the MINER Act, the whip count, the CRA resolution, the $9 to $10 million in lobbying — went to copper-nickel mining for a Chilean company whose minerals would be shipped to China for processing.

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The proposed mine sits within the 1854 Ceded Territory.

The Ojibwe have lived in this region for centuries. They fish the same walleye waters their grandparents fished. They gather medicines from the same forests. They harvest the same rice. This is not history. It is ongoing. Families feed themselves from this water today.

In 1854, the federal government wanted access to mineral deposits on the north shore of Lake Superior. The Ojibwe bands who lived there — the Fond du Lac, the Bois Forte, the Grand Portage — held the land. The government proposed a treaty. The bands refused to sign unless they retained the right to hunt, fish, and gather on the ceded territory. Both sides agreed. The treaty was signed on September 30, 1854, at La Pointe. It is sometimes called the Copper Treaty, because the government's purpose was mining.

Article 11 reserves those rights. For more than a century, the state of Minnesota ignored them, enforcing state game laws against tribal members as if the treaty did not exist. Beginning in the 1980s, federal courts disagreed. In 1996, a federal judge ruled the rights were never extinguished. In 1999, the U.S. Supreme Court

held that treaty rights can only be ended if Congress is "clear and plain" in its intent. The bands are recognized as co-equal managers of the natural resources in the ceded territory.

The Fond du Lac Band holds water quality standards more stringent than the state's, upheld by the EPA. In 2023, the band used its authority under the Clean Water Act to suspend a federal wetlands permit for PolyMet — the first time a tribe had used that power to block a mine permit. The 1854 Treaty Authority, representing Grand Portage and Bois Forte, employs its own conservation officers, cross-deputized with the Minnesota DNR. It conducts fish population surveys and wild rice restoration — because the right to fish is meaningless if the water cannot support fish, and the right to gather is meaningless if the rice is dead.

Wild rice is highly sensitive to sulfate. Sulfate is a direct byproduct of sulfide-ore mining.

The Minnesota Chippewa Tribe, representing all six Chippewa bands in the state, voted unanimously to oppose the resolution that overturned the mining moratorium. The National Congress of American Indians passed an emergency resolution protesting that the resolution was advanced without tribal testimony or consultation. Indigenous lawmakers called the vote "an assault on tribal sovereignty."

The government signed the 1854 Treaty to gain access to minerals. The bands signed it to keep their relationship to the water. The agreement is 172 years old. In 2026, Congress acted on the minerals without consulting the other party to the agreement.

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In 1978, the House of Representatives voted 324 to 29 to protect the Boundary Waters. The Senate passed it by voice vote without opposition. Republican senators were among its champions.

On January 21, 2026, the House voted 214 to 208 to overturn the 20-year mineral withdrawal protecting the same wilderness. On

April 16, the Senate voted 50 to 49. Three Republicans voted no; one Democrat voted yes. Every Minnesota Republican voted to open the watershed. Every Minnesota Democrat voted to keep it closed. Senator Tina Smith spoke for nearly five hours attempting to block the vote. Theodore Roosevelt's great-grandson wrote to Republican senators urging them to protect the Boundary Waters. He said the former president would be "appalled."

Tom Emmer represents Minnesota's Sixth Congressional District. The mine would not be in his district. The jobs would not be in his district. But his constituents own more cabin and recreational property near the Boundary Waters than residents of any other district in the state. The nearly $10 billion in seasonal recreational property assessed across the Arrowhead region includes lakefront cabins and hunting land whose value depends entirely on clean water. Peer-reviewed research shows property values drop 11 to 22% when nearby water receives an EPA impairment designation. In mining towns that have experienced the bust cycle, property values have fallen 66 to 76%.

His lifetime score from the League of Conservation Voters is 3%. In 2024 it was 0%.

The resolution was introduced under the Congressional Review Act, which requires only a simple majority — no filibuster. When signed, it does two things: it rescinds the 20-year mineral withdrawal on 225,504 acres, and it permanently bars the Interior Department from issuing a "substantially similar" protection without new legislation.

A future president cannot reimpose the ban. The back-and-forth that protected the wilderness for decades — one administration blocks the leases, the next reinstates them, the next blocks them again — has been ended by statute.

Six hundred seventy-five thousand public comments were submitted during the environmental review. Approximately 98% supported the ban. Fifty-seven percent of Minnesotans oppose

mining in the Boundary Waters watershed. Fifty percent of Minnesota Republicans call its protection a "very important priority."

The vote was 214 to 208 and 50 to 49.

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The water is still there. The 1,100 lakes are still clear. The loons still nest along the shorelines. In late August, the harvesters still go out in canoes — 18 feet, no motor, two wooden sticks — and take only what the rice can spare.

The mine has not been built. State permits are required — 18 to 20 of them. Legal challenges are expected. The Fond du Lac Band's water quality standards remain in force. Construction, if all hurdles clear, would take 3 to 7 years.

But the federal protection is gone. The moratorium that was based on two years of environmental study, 20 individual resource reports, and 675,000 public comments has been nullified by a party-line vote. The statute prevents any future administration from restoring it without an act of Congress.

In the same rock, a clean resource sits untouched — one that does not threaten the water, does not require centuries of treatment, and addresses a national shortage more urgent than the one the copper mine claims to solve.

The minerals beneath the Boundary Waters sit on public land. The profits would flow to a private company in Santiago. The minerals would be processed in China. The 750 jobs — by the company's estimate, for 25 years — would go disproportionately to workers from outside the community, for a company building remote operations centers to replace them. Comparable mines have lasted 13 to 16 years.

The land is public. The risk is public. The cleanup is public. The gains are private — and foreign. Under the General Mining Act of 1872, hardrock miners pay zero federal royalties on minerals extracted from public land. Over $300 billion has been extracted

under this law without royalty compensation to the American taxpayer.

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Wild rice regulations -- MN Statutes 84.091-84.15; MN DNR. BWCA statistics -- USFS; Wilderness Connect. Duluth Complex -- USGS; Minnesota Geological Survey. Ely demographics and tourism -- U.S. Census Bureau; Ely Chamber of Commerce; Explore Minnesota Tourism. Resident quotes -- Ely Echo (Erzar, Feb 2025); MPR News (Tyler, Feb 2024); KARE 11 (Leary, Apr 2026). Twin Metals mine plan and job claims -- Twin Metals 2019 Mine Plan of Operations; PolyMet/NewRange EIS. Smelter data -- USGS Mineral Commodity Summaries 2025. Butte -- U.S. Census Bureau; EPA Superfund; Montana DPHHS. Harvard study -- Stock and Bradt, Ecological Economics, March 2020. Fabrizio Ward poll -- 2017 (Trump-aligned pollster). Antofagasta corporate and financial -- Antofagasta PLC Annual Report 2025; sustainability reports. Chile violations -- Chilean SMA; Reuters; The Guardian. Sulfide chemistry -- EPA; Nordstrom and Alpers (1999). Mining failure studies -- Earthworks (2012); Kuipers and Associates (2006); 2025 study. Wisconsin Prove It First -- Wisconsin Act 134 (1997). BWCA geology and watershed -- USFS Environmental Assessment (2022); MPCA; IJC. Mercury methylation -- Dr. Steve Engstrom (2016); MN Dept of Health. Historical AMD -- EPA Superfund; USGS; AP News. Eagle Mine -- Michigan DEQ/E-GLE; Lundin Mining. MINER Act -- Congress.gov H.R. 3905 (115th). WilmerHale -- LDA filings; Washington Post; FOIA records. Kushner mansion -- Washington Post; DC property records. Jorjani memo -- DOI M-37049; FOIA. Lobbying -- OpenSecrets; MN Campaign Finance Board. H.J. Res. 140 -- House Roll Call #38; Senate roll call. Helium discovery -- Pulsar Helium filings; USGS; Lawrence Livermore. Federal Helium Reserve -- BLM; Helium Stewardship Act of 2013; Messer press release. 1854 Treaty -- Treaty of La Pointe (1854), 10 Stat. 1109; Mille Lacs Band v. Minnesota (1999). Fond du Lac -- EPA TAS determinations; PolyMet permitting records. Tribal opposition -- MCT resolution; NCAI emergency resolution. 1978 BWCA Act -- P.L. 95-495. Property values -- Arrowhead county assessors; hedonic pricing studies. LCV scores -- LCV National Environmental Scorecard. CRA mechanism -- 5 U.S.C. 801-808. Polling -- Impact Research; Fabrizio Ward. General Mining Act -- 30 U.S.C. 22-54; GAO; Taxpayers for Common Sense.

THE DEPOSIT

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What is under the ground

About 1.1 billion years ago, North America tried to split apart. A crack 1,200 miles long opened from what is now Kansas through Lake Superior and into Michigan. Magma from deep in the Earth's mantle rose through the crack. The continent did not split. The rift failed, and the magma cooled underground into a formation geologists call the Duluth Complex.

The complex covers more than 2,000 square miles of northeastern Minnesota. In places it is 10 miles thick. It is the second-largest formation of its type on Earth, after the Bushveld Complex in South Africa.

As the magma rose, it intruded into older rocks that were rich in sulfur and absorbed sulfur from them. The added sulfur pushed the magma past a tipping point. A separate liquid — rich in sulfide — separated out inside the magma, like oil separating from water. These sulfide droplets were heavier than the surrounding magma. They sank, and as they sank they collected copper, nickel, platinum, palladium, and cobalt, concentrating them into layers at the bottom of the formation.

The richest layers sit along the northwestern edge of the complex, where the magma first contacted the sulfur-rich rock. That edge runs in an arc from Duluth to the Canadian border, directly through the Ely and Babbitt area — the watershed that drains into the Boundary Waters.

The deposit contains an estimated 4.4 billion tons of ore. It is the world's largest undeveloped copper-nickel deposit, the third-largest accumulation of nickel sulfides, and the second-largest for combined copper and platinum-group elements.

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How sulfide mining works

The target metals make up a tiny fraction of the rock — copper and nickel less than 1%, platinum-group metals far less than that. Extracting them requires four stages.

Stage 1: Crush. The ore is brought to the surface and ground into fine powder — roughly the consistency of flour. This maximizes the surface area for chemical separation. For every ton of usable metal, approximately 99 tons of waste rock and powder are produced.

Stage 2: Float. The powder is mixed with water and chemical agents in large tanks. The agents make sulfide minerals repel water. Air is pumped through the mixture, creating bubbles. The sulfide particles attach to the bubbles and float to the surface as foam. This foam — the "concentrate" — is skimmed off. Everything that sinks is waste, called tailings.

Stage 3: Smelt. The concentrate is heated in a furnace until the metals separate from the remaining rock. The waste rock melts and floats to the top, where it is scraped off. The heavier metal mixture sinks to the bottom.

Stage 4: Refine. The crude metal mixture is further cleaned — either by blowing oxygen through the molten material to burn off remaining impurities, or by dissolving it in chemical solutions

and using electricity to plate out pure metal. The final product is sheets of 99.9% pure copper or nickel.

The process is energy-intensive and produces two major categories of waste: waste rock (excavated but not processed) and tailings (the powdered leftovers from flotation). Both contain exposed sulfide minerals — the source of the contamination problem described below.

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Why it contaminates water

The problem is not the mining itself. The problem is what happens to the waste after the mining stops.

Minnesota has mined iron ore on the Iron Range for over a century. The lakes near those mines are still fishable. The difference is chemistry. Iron ore on the Range is oxide — iron bonded to oxygen. When you crush oxide ore, it does not make acid. Sulfide ore — iron bonded to sulfur — does. That one difference changes everything.

Sulfide minerals are stable underground, where there is no air and limited water. Mining brings them to the surface, crushes them into powder, and exposes them to both. What follows is a self-sustaining chain reaction called acid mine drainage.

Step 1. Sulfide minerals — most commonly pyrite, also called fool's gold — react with oxygen and water to produce sulfuric acid and dissolved iron.

Step 2. The dissolved iron transforms into a more reactive form. Think of it as rust, but supercharged.

Step 3. This reactive iron attacks more sulfide rock, producing more acid and more dissolved iron — which transforms again and attacks more rock. The reaction feeds itself. It is a chemical fire that never burns out.

Step 4. Naturally occurring bacteria thrive in these conditions and speed up the reaction — typically 10 to 1,000 times faster in the field, up to 100,000 times faster under laboratory conditions.

Once this cycle begins, it continues as long as there is air, water, and sulfide mineral. In northern Minnesota, which receives 30 inches of precipitation a year and the ground freezes and thaws every spring, all three conditions are permanent.

What the acid does to water

The sulfuric acid makes nearby water as acidic as lemon juice or vinegar. At the most extreme sites, such as Iron Mountain in California, drainage has been measured at levels more acidic than battery acid. Most aquatic life dies long before water reaches those levels.

The acid also acts as a solvent. As it flows through waste rock and tailings, it dissolves heavy metals — copper, nickel, lead, mercury, arsenic, cadmium — and carries them into groundwater and streams.

When acidic water eventually reaches clean water downstream, the dissolved iron turns back into a solid — a thick orange sludge called "yellow boy." This sludge coats streambeds, smothers fish eggs, clogs fish gills, and kills the bottom-dwelling insects that form the base of the aquatic food chain.

Heavy metals that enter the water are absorbed by algae, eaten by insects, eaten by small fish, eaten by larger fish, and eaten by people. Concentrations increase at each step — a process called biomagnification. What is harmless at the bottom of the food chain becomes dangerous at the top.

Why the Boundary Waters is uniquely vulnerable

Not all landscapes react the same way to acid mine drainage. The Boundary Waters is worse than most, for specific geological reasons:

- **No natural buffering.** In some regions, limestone in the bedrock neutralizes acid on contact. The rock beneath the Boundary Waters is ancient, hard granite — part of the Canadian Shield, some of the oldest exposed rock on Earth. It contains almost no limestone. Once acid enters the water, nothing in the geology neutralizes it.
- **Interconnected watershed.** The mine site sits in the Rainy River watershed. Water flows north from the site into the heart of the wilderness, through Voyageurs National Park, down the Rainy River, and into Lake of the Woods — a distance of roughly 370 miles. There is no point in this chain where contamination can be isolated.
- **Mercury conversion.** The acid-producing process also releases sulfate — a chemical compound of sulfur — into the water. Sulfate feeds bacteria in lake sediments. Those bacteria change the mercury already present in the environment into a form that fish absorb and cannot get rid of. The mercury concentrates as it moves up the food chain — from insects to small fish to walleye to the person who eats the walleye. Fish in some Boundary Waters lakes already carry mercury at 3 to 7 times the level the EPA considers safe. Additional sulfate from mining would make this worse.
- **Wild rice.** Wild rice — *manoomin* to the Ojibwe — is extraordinarily sensitive to sulfate. Its roots die when sulfate concentrations rise above 10 milligrams per liter, one of the strictest water quality standards in the country. Minnesota adopted this standard specifically to protect wild rice beds. Acid mine drainage is a sulfate delivery system. The same process that poisons fish also kills the food that has sustained indigenous communities in this watershed for centuries.
- **Freeze-thaw cycle.** Northern Minnesota winters reach 30 to 40 degrees below zero. Every spring, the ground thaws and refreezes dozens of times. This is the same cycle that de-

stroys Minnesota roads every spring. It cracks concrete, splits liners, and opens seams in any containment structure built to hold waste. Tailings dams, caps, and covers designed for arid climates — where the ground stays dry and stable year-round — face conditions here that stress them every season. The containment does not need to fail catastrophically. It needs to develop one crack, once, and water finds it.

- **International boundary.** The watershed crosses into Manitoba, Canada. A mine in Minnesota could contaminate Canadian water, creating an international incident governed by the International Joint Commission.

How long it lasts

Acid mine drainage is not a temporary problem. It lasts as long as there is sulfide mineral exposed to air and water — which, in a crushed waste pile, can mean thousands of years. Longer than any government or company has ever existed.

- Roman-era copper mines at Rio Tinto, Spain, have produced acid drainage continuously for over 2,000 years.
- Iron Mountain, California, will produce acid for an estimated 2,500 to 3,000 more years.
- The PolyMet environmental impact study — for the other proposed mine in Minnesota — assumes water treatment will be required for 200 years at the mine site and 500 years at the processing site.

An obvious question: why not put the waste back underground? Because you cannot un-crush powder back into solid rock. The mining process ground it into flour-sized particles, creating an enormous surface area that did not exist before. Even underground, water would find it, air would reach it, and the acid reaction would begin. Backfilling slows the process. It does not stop it.

There is no known method to permanently stop acid mine drainage once it begins at scale. Every operational plan assumes active water treatment — pumping, neutralizing, filtering, monitoring — for centuries, paid for by someone.

* * *

The track record

The mining industry describes its proposed methods as "21st-century mining" — underground extraction, dry-stack tailings, real-time monitoring, advanced water treatment. These designs are real. They are also untested at this location and in this climate.

The historical record for sulfide mines operating near water:

Study	Sample	Finding
Earthworks (2012)	14 major U.S. copper sulfide mines	All 14 experienced spills or accidental releases
Kuipers and Associates (2006)	25 modern hardrock mines	All 25 exceeded water quality standards, despite predicting they would not
Peer-reviewed study (2025)	8 mines permitted since 1990	All 8 degraded downstream water quality

From 1998 to 2017, Wisconsin maintained a law called "Prove It First." It required any company proposing a sulfide mine to name a single example of a comparable mine anywhere in the world that had operated for 10 years and been closed for 10 years without polluting surrounding water. In 19 years, no mining company on Earth could meet the standard. The law was repealed — not because an example was found, but because the legislature changed.

What perpetual treatment costs

Category	Range	Examples
Treatment plant construction	$15 million – $35 million	Berkeley Pit, MT ($19M); Iron Mountain, CA ($20M+)
Annual operations	$3 million – $6 million per year, indefinitely	Eagle Mine, MI (~$6M); Iron Mountain (~$5M)
Financial assurance bonds	$50 million – $544 million	PolyMet ($544M); Eagle Mine (~$55M)
Perpetual trust funds	$500 million – $1 billion	Iron Mountain ($514M "forever fund" payment due 2030)

The EPA currently manages over 40 hardrock mine Superfund sites that collectively produce 17 to 27 billion gallons of polluted water annually. Each requires treatment that will never end. Modern regulations require financial assurance bonds — PolyMet's $544 million bond is listed above. But bonds are sized to estimated costs, and estimates have historically fallen short. When the mining company goes bankrupt — as the operator at Summitville, Colorado, did after posting a $4.5 million bond on a site that has cost over $200 million to clean up — the gap between the bond and the actual cost transfers to taxpayers.

* * *

Where else these minerals exist

The argument for mining the Boundary Waters watershed rests on two claims: that these minerals cannot be obtained elsewhere, and that domestic supply is a national security imperative because China and Russia dominate global processing and supply chains for nickel, cobalt, and platinum-group metals. The national security argument is real. The question is whether it requires mining this specific deposit, in this specific watershed, when domestic alternatives exist. The supply claim is partially true for

nickel and largely false for copper.

Copper

The United States already produces substantial copper without touching the Duluth Complex. Arizona alone accounts for roughly 74% of domestic output. These deposits are in arid regions with no major freshwater watersheds at risk.

Mine or project	Location	Status
Morenci	Arizona	Active — largest copper mine in North America
Bingham Canyon	Utah	Active — one of the world's largest
Resolution Copper	Arizona	Advancing — could supply 25% of U.S. copper demand; contested (Apache sacred site at Oak Flat)
Copper World	Arizona	Development — on private land
Robinson	Nevada	Active — mine life extended to 2039
Florence Copper	Arizona	First commercial harvest expected 2026 (in-situ method)

Copper is not the bottleneck. The argument for the Duluth Complex is not primarily about copper.

Nickel

Nickel is the harder case. The United States is approximately 95% import-dependent for nickel, and the Duluth Complex is the largest known domestic deposit. But it is not the only one.

Mine or project	Location	Status	Watershed risk
Eagle Mine	Michigan	Active — only operating U.S. nickel mine (closing ~2026–2029)	Near Lake Superior; underground; smaller footprint
Tamarack	Minnesota (Aitkin County)	Permitting — high-grade Ni-Cu-Co	Outside the Boundary Waters watershed entirely
Stillwater West	Montana	Exploration — Ni-Cu-Co with PGMs	Semi-arid mountain; no comparable freshwater system
Red Flat / Cleopatra	Oregon	Early exploration — nickel laterite	Sensitive botanical area but not a major lake system

The Tamarack project is the most direct answer. It is a high-grade nickel-copper-cobalt deposit in a different part of Minnesota that drains to a different watershed. It has a supply agreement with Tesla for 75,000 metric tonnes of nickel concentrate and has received Department of Defense funding as a strategic domestic source. It exists. It does not threaten the Boundary Waters.

Platinum group metals

The Stillwater and East Boulder mines in Montana are the only primary source of platinum and palladium in the United States. They operate without threatening a wilderness-scale freshwater system.

* * *

What else could work

Several extraction technologies do not require conventional open-pit or underground sulfide mining.

Mining without digging

Instead of digging ore out of the ground, a method called in-situ recovery injects a weak acid solution — comparable in strength to household vinegar — into underground ore through wells. The solution dissolves copper minerals in place. The copper-rich fluid is pumped to the surface and processed into 99.9% pure copper through electroplating.

No open pit. No tailings dam. No blasting, hauling, or crushing of rock. The surface is left largely undisturbed.

The Florence Copper project in Arizona claims a 75% reduction in greenhouse gas emissions, 65% less energy, and 78% less water compared to conventional open-pit mining. Its first commercial copper harvest is expected in early 2026. The technology works for copper oxide deposits. It does not work for nickel sulfides.

Phytomining

Some plants are so hungry for nickel they pull it straight out of the ground and store it in their leaves. The plants are harvested like a crop and processed to recover the metal. No digging. Potentially carbon-negative when combined with rock weathering.

The Department of Energy's ARPA-E program has funded pilot-scale phytomining projects in southern Oregon. The technology is pre-commercial and cannot approach conventional mining volumes yet, but it demonstrates that alternatives are under active development.

Geothermal brine extraction

At the Salton Sea in California, lithium and other minerals are extracted from hot, mineral-rich fluids already being pumped for geothermal power generation. The process has minimal surface footprint and avoids the evaporation ponds and water consumption of conventional lithium mining. The principle — extracting minerals from fluids that are already being handled for another purpose — applies beyond lithium.

Mine tailings reprocessing

The United States has billions of tons of mine waste already sitting on the surface from a century of previous mining. Some of this waste contains minerals that were uneconomical to extract when the mines operated but are now recoverable with modern processing.

- Missouri Cobalt reprocesses old lead-zinc tailings to recover cobalt, nickel, and copper.
- USGS research at Bingham Canyon (Utah) has identified significant tellurium and other critical minerals in existing copper tailings.
- A 2025 study from the Colorado School of Mines found that recovering just 10% of the cobalt already discarded in U.S. mine waste could meet the entire domestic battery market demand.

Reprocessing turns environmental liabilities into resources without digging a single new hole.

Recycling

Recycled copper already provides approximately 33% of U.S. domestic supply — roughly 700,000 metric tons per year. Battery recycling is the fastest-growing segment of critical minerals recovery, with companies processing end-of-life electric vehicle batteries to recover nickel, cobalt, and lithium. Recycled cobalt supplied 25% of U.S. consumption in 2024.

Recycling does not replace mining. These figures reflect current demand. The global energy transition — electric vehicles, wind turbines, solar panels, grid infrastructure — is projected to double or triple copper and nickel requirements by 2040. No single source, including the Duluth Complex, would satisfy that growth alone. But recycling reduces how much new mining is needed and buys time for lower-impact extraction technologies to scale.

* * *

The arithmetic

The Duluth Complex is the world's largest undeveloped copper-nickel deposit. That is a geological fact. But "largest undeveloped" is not the same as "only option." It is the most convenient option — the most mineral in one place, for a single mining operation, under a single set of leases.

The convenience is real. So is this:

- Copper is abundant in the American Southwest, in arid regions far from major freshwater systems.
- Nickel exists at Tamarack, in the same state, draining to a different watershed.
- Platinum comes from Montana without threatening a wilderness area.
- Cobalt can be recovered from waste we have already dug up.
- New extraction technologies are producing copper without open pits or tailings.

Every sulfide mine studied — 14 of 14, 25 of 25, 8 of 8 — has contaminated nearby water. No company in 19 years could name a single exception. The company proposing this mine has never operated in the United States. The minerals would be processed overseas. Under the General Mining Act of 1872, zero federal royalties are paid on minerals extracted from public land. If the company fails, taxpayers inherit the treatment obligation — which, based on every comparable site, lasts centuries.

The question is not whether the minerals are valuable. They are. The question is whether this particular deposit — beneath the watershed of 1,100 lakes, in a wet climate with no natural acid buffering, draining across an international boundary into water that indigenous people have harvested for centuries under a treaty the federal government signed — is the right place to ex-

tract them, when alternatives exist.

* * *

Duluth Complex geology -- Minnesota Geological Survey (Report of Investigations 58); USGS Mineral Commodity Summaries; Miller et al. (2002). Midcontinent Rift -- USGS; University of Minnesota Digital Conservancy; Sims (1968). Sulfide mining process -- EPA; Minnesota DNR. Acid mine drainage chemistry -- EPA acid mine drainage documentation; Nordstrom and Alpers (1999). Bacterial catalysis -- Acidithiobacillus ferrooxidans literature; Fondriest Environmental. Boundary Waters geology and watershed -- USFS Superior National Forest Environmental Assessment (Federal Register 87 FR 38373, June 28, 2022); MPCA; IJC. Mercury methylation -- Dr. Steve Engstrom (2016); MN Department of Health fish consumption advisories. Mining failure studies -- Earthworks (2012); Kuipers and Associates (2006); 2025 peer-reviewed study. Wisconsin Prove It First -- Wisconsin Act 134 (1997). Iron Mountain -- EPA Superfund; DOJ settlement records. Berkeley Pit -- EPA Superfund; Montana DEQ. Summitville -- EPA Superfund; GAO. Rio Tinto (Spain) -- USGS; geological literature. Eagle Mine -- Michigan DEQ/EGLE monitoring reports; Lundin Mining. PolyMet financial assurance -- Minnesota DNR; PolyMet/NewRange EIS. Treatment costs -- EPA; mine closure literature; financial assurance filings. Domestic copper production -- USGS Mineral Commodity Summaries 2025; Freeport-McMoRan; Rio Tinto/BHP (Resolution Copper). Domestic nickel -- USGS; Talon Metals; Eagle Mine reports. Tamarack -- Talon Metals/Rio Tinto filings; DOD critical minerals funding; Tesla supply agreement. Stillwater -- Sibanye-Stillwater; USGS. In-situ copper recovery -- Taseko Mines (Florence Copper); company filings and environmental data. Phytomining -- DOE ARPA-E; Metalplant; University of Oregon. Geothermal brine -- DOE; Salton Sea lithium projects. Tailings reprocessing -- Colorado School of Mines (2025); USGS Earth MRI; Missouri Cobalt. Recycling -- USGS; industry data; Nth Cycle; Redwood Materials. Wild rice sulfate standard -- Minn. R. 7050.0224, subp. 2; MPCA. General Mining Act -- 30 U.S.C. 22-54; GAO; Taxpayers for Common Sense.

This chapter ends here.

The full book continues through nineteen chapters
and five parts — the representative's record,
the donor patterns, the machine that sustains it,
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