AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

H. CON. RES. 34; AND H.R. 3195, SUPERIOR NATIONAL FOREST RESTORATION ACT

LEGISLATIVE HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES

OF THE

COMMITTEE ON NATURAL RESOURCES
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED EIGHTEENTH CONGRESS

FIRST SESSION

Thursday, May 11, 2023

Serial No. 118–24

Printed for the use of the Committee on Natural Resources

Available via the World Wide Web: http://www.govinfo.gov
or
Committee address: http://naturalresources.house.gov

U.S. GOVERNMENT PUBLISHING OFFICE
52–298 PDF WASHINGTON : 2023

COMMITTEE ON NATURAL RESOURCES

BRUCE WESTERMAN, AR, *Chairman*
DOUG LAMBORN, CO, *Vice Chairman*
RAÚL M. GRIJALVA, AZ, *Ranking Member*

Doug Lamborn, CO
Robert J. Wittman, VA
Tom McClintock, CA
Paul Gosar, AZ
Garret Graves, LA
Aumua Amata C. Radewagen, AS
Doug LaMalfa, CA
Daniel Webster, FL
Jenniffer González-Colón, PR
Russ Fulcher, ID
Pete Stauber, MN
John R. Curtis, UT
Tom Tiffany, WI
Jerry Carl, AL
Matt Rosendale, MT
Lauren Boebert, CO
Cliff Bentz, OR
Jen Kiggans, VA
Jim Moylan, GU
Wesley P. Hunt, TX
Mike Collins, GA
Anna Paulina Luna, FL
John Duarte, CA
Harriet M. Hageman, WY

Grace F. Napolitano, CA
Gregorio Kilili Camacho Sablan, CNMI
Jared Huffman, CA
Ruben Gallego, AZ
Joe Neguse, CO
Mike Levin, CA
Katie Porter, CA
Teresa Leger Fernández, NM
Melanie A. Stansbury, NM
Mary Sattler Peltola, AK
Alexandria Ocasio-Cortez, NY
Kevin Mullin, CA
Val T. Hoyle, OR
Sydney Kamlager-Dove, CA
Seth Magaziner, RI
Nydia M. Velázquez, NY
Ed Case, HI
Debbie Dingell, MI
Susie Lee, NV

Vivian Moeglein, *Staff Director*
Tom Connally, *Chief Counsel*
Lora Snyder, *Democratic Staff Director*
http://naturalresources.house.gov

SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES

PETE STAUBER, MN, *Chairman*
WESLEY P. HUNT, TX, *Vice Chair*
ALEXANDRIA OCASIO-CORTEZ, NY, *Ranking Member*

Doug Lamborn, CO
Robert J. Wittman, VA
Paul Gosar, AZ
Garret Graves, LA
Daniel Webster, FL
Russ Fulcher, ID
John R. Curtis, UT
Tom Tiffany, WI
Matt Rosendale, MT
Lauren Boebert, CO
Wesley P. Hunt, TX
Mike Collins, GA
John Duarte, CA
Bruce Westerman, AR, *ex officio*

Jared Huffman, CA
Kevin Mullin, CA
Sydney Kamlager-Dove, CA
Seth Magaziner, RI
Nydia M. Velázquez, NY
Debbie Dingell, MI
Raúl M. Grijalva, AZ
Grace F. Napolitano, CA
Susie Lee, NV
Vacancy
Vacancy

CONTENTS

Page

Hearing held on Thursday, May 11, 2023 1

Statement of Members:

Stauber, Hon. Pete, a Representative in Congress from the State of Minnesota 1
Ocasio-Cortez, Hon. Alexandria, a Representative in Congress from the State of New York 3

Statement of Witnesses:

Bakk, Hon. Thomas, Member of Minnesota Senate (Retired), Cook, Minnesota 4
Prepared statement of 6
Thorleifson, Harvey, Professor, Department of Earth and Environmental Sciences, University of Minnesota, Minneapolis, Minnesota 8
Prepared statement of 10
Rom, Becky, National Chair, Campaign to Save the Boundary Waters, Ely, Minnesota 11
Prepared statement of 13
Questions submitted for the record 32
Chura, David, Board Chair, Jobs for Minnesotans, Duluth, Minnesota 56
Prepared statement of 57
Questions submitted for the record 60

Additional Materials Submitted for the Record:

Submissions for the Record by Representative Stauber

Testimony of Dean Peterson at the May 2, 2023 Field Hearing 64
Minnesota House of Representatives, Letter from State Representative Skraba, dated May 10, 2023 96
Iron Range Delegation, Letter from Representatives, dated May 9, 2023 97
International Union of Operating Engineers, Local 49, Letter, dated May 10, 2023 98
Range Association of Municipalities and Schools (RAMS), Letter, dated May 9, 2023 99
Advance Energy United, Letter 100
MiningMinnesota, Letter, dated May 11, 2023 101
Conservationists with Common Sense (CWCS), Letter 101
Global Minerals Engineering (GME), Letter, dated May 10, 2023 102
National Mining Association (NMA), Statement for the Record 105
Duluth News Tribune, Opinion Column by Rens Verburg, dated January 14, 2022 106
Up North Jobs Petition 107
H. Con. Res. 34 support emails sent to Rep. Stauber's office 107

Submissions for the Record by Representative Ocasio-Cortez

Star Tribune, article titled, "Minnesota Power looks to ratepayers to recover mine and mill losses," by Brooks Johnson, dated November 10, 2020 113

Submissions for the Record by Representative Grijalva

Opening Statement 79
Department of the Interior—Statement for the Record on H. Con. Res. 34 111

Submissions for the Record by Representative Fulcher

U.S. Net Import Reliance from USGS, shown during hearing 114
China Copper Supply Chain, shown during hearing 115

Page

Additional Materials Submitted for the Record—Continued
Submissions for the Record by Representative Westerman
The Role of Nonfuel Mineral Commodities in the USA, shown during hearing 115
Submissions for the Record by Representative Duarte
Map of Forest Watershed and Mineral Deposit, shown during hearing 116
Boundary Waters Aerial Photo, shown during hearing 116
Submissions for the Record by Representative Gosar
Canadian Map of Boundary Waters, shown during hearing 117

LEGISLATIVE HEARING ON H. CON. RES. 34, EXPRESSING DISAPPROVAL OF THE WITHDRAWAL BY THE SECRETARY OF THE INTERIOR OF APPROXIMATELY 225,504 ACRES OF NATIONAL FOREST SYSTEM LANDS IN COOK, LAKE, AND SAINT LOUIS COUNTIES, MINNESOTA FROM DISPOSITION UNDER THE UNITED STATES MINERAL AND GEOTHERMAL LEASING LAWS; AND H.R. 3195, TO RESCIND PUBLIC LAND ORDER 7917, TO REINSTATE MINERAL LEASES AND PERMITS IN THE SUPERIOR NATIONAL FOREST, TO ENSURE TIMELY REVIEW OF MINE PLANS OF OPERATIONS, AND FOR OTHER PURPOSES, "SUPERIOR NATIONAL FOREST RESTORATION ACT"

Thursday, May 11, 2023
U.S. House of Representatives
Subcommittee on Energy and Mineral Resources
Committee on Natural Resources
Washington, DC

The Subcommittee met, pursuant to notice, at 10:04 a.m., in Room 1324, Longworth House Office Building, Hon. Pete Stauber [Chairman of the Subcommittee] presiding.

Present: Representatives Stauber, Lamborn, Gosar, Graves, Fulcher, Tiffany, Rosendale, Collins, Duarte, Westerman; Ocasio-Cortez, Huffman, Kamlager-Dove, and Grijalva.

Mr. STAUBER. The Subcommittee on Energy and Mineral Resources will come to order.

Without objection, the Chair is authorized to declare a recess of the Subcommittee at any time.

Under Committee Rule 4(f), any oral opening statements at hearings are limited to the Chairman and the Ranking Minority Member.

I now recognize myself for an opening statement.

STATEMENT OF THE HON. PETE STAUBER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MINNESOTA

Mr. STAUBER. Welcome, all of you here and those watching online, to the Energy and Mineral Resources Subcommittee. Today, we will consider two bills that will help put America back in control of our critical mineral supply by mining here.

Minerals play a vital role in America's economy. Control of our supply of these minerals is a strategic national security concern for the United States and our allies. Because of the Biden administration's opposition to domestic mining, we are woefully reliant on foreign sources of minerals mined in appalling environmental and labor conditions. Instead, we can mine here.

In northern Minnesota, mining is part of our way of life. For 140 years, we have mined the iron that won two world wars and built America. Today, the mining communities throughout the Iron Range provide the feedstock that accounts for 80 percent of America's steelmaking. And now this region has an opportunity to supplement its iron production with the Duluth Complex, which accounts for 95 percent of America's nickel, nearly 90 percent of our cobalt, 75 percent of our platinum, and more than a third of our copper.

The Superior National Forest, which partially covers the Duluth Complex, includes 1 million acres of federally protected wilderness and a surrounding mining protection area set up in statute. In the remaining 2 million acres, mineral development is a desired condition of the forest plan. When the wilderness and its buffer zone were established, my predecessor, Congressman Jim Oberstar, a lifelong Democrat, wrote to then-President Jimmy Carter requesting he not take our livelihoods away, meaning mining and timber harvesting.

With only 16 days left of his administration, President Obama pulled the Federal leases and moved to ban mining for purely political reasons. President Trump rightfully reinstated the leases and canceled the 20-year ban. Now, the Biden administration has once again pulled the mining leases and put forth a 20-year mining ban. To make matters worse, the Secretary of the Interior, who signed off on the mineral ban, stated twice under oath that she didn't even know that critical minerals were there.

It is well past time for Congress to claw back its authority on these important issues. Therefore, I offer legislation today to right these wrongs. House Concurrent Resolution 34 exercises an authority passed by Congress, signed by the President, and enshrined in statute. It allows for Congress to overturn withdrawals of more than 5,000 acres.

H.R. 3195, the Superior National Forest Restoration Act, not only overturns the harmful mining ban, but also reinstates the leases dating back to 1966; requires full consideration of the project-specific mine plan of operation, including the full Environmental Impact Statement; and exempts these actions from judicial review.

Neither of these proposals "fast track" or "greenlight" a project.

Now, remember, opponents of the project here today will change the narrative. They will try and make today about the already federally protected area. They will ignore the fact that the Interior Secretary had no idea there were critical minerals in the withdrawal area. They will ignore the Project Labor Agreement signed with the Iron Range Building and Construction Trades, and they will ignore the open pit gold mine in Canada permitted in 3 years in the same watershed that flows into another part of my district, Lake of the Woods.

We have clean water and mining. We have projects that propose using state-of-the-art technologies like dry stack tailings that would prevent any problems. So, let's pass these bills and study the full Environmental Impact Statement, which is the highest scrutiny allowed under the Federal Government. Let's mine the minerals we need for our defense applications, modern technology, and everyday use with American labor in northern Minnesota.

Thank you, and I yield to my colleague from New York, Ranking Member Ocasio-Cortez.

STATEMENT OF THE HON. ALEXANDRIA OCASIO-CORTEZ, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW YORK

Ms. OCASIO-CORTEZ. Thank you, Chair Stauber.

Today, before this Committee we are considering a mining project that has already been rejected through scientific review.

And while we are talking about the Boundary Waters today, we could just as easily be talking about Oak Flat or Rosemont or any number of extractive projects where corporations have continued to ignore the evidence and science, and push a profit agenda at the expense of nearby communities and ecosystems. These corporations can do this because, as we see today, the private sector has captured influence in many areas of our government. But from many of the questions we may be hearing, to statements we will be witnessing, and information provided, much of this hearing could have very well been orchestrated by the interests that seek to have this project renewed.

So, what are the Boundary Waters? The Boundary Waters in northeastern Minnesota are pristine wilderness, but it is not luck that has kept these waters clean and made the wilderness there a sanctuary for endangered species. The Boundary Waters has more than a century-long history of Federal protections. Through treaties with Canada in 1909 and later the Wilderness Act of 1964, our country has long recognized the importance of preserving the Boundary Waters. And for countless generations before that, and to this day, the Ojibwe or Chippewa people have stewarded the land and waters and continue to gather, hunt, fish, and harvest in and around the area.

The Boundary Waters supports a thriving outdoor recreation economy with hundreds of thousands of annual visitors and tens of thousands of jobs across northeastern Minnesota, and yet this region and its resources have been under threat for years.

In 2012, Twin Metals Minnesota, a wholly-owned subsidiary of the Chilean mining company Antofagasta, requested an extension of two expired leases on Forest Service land in the Boundary Waters watershed to build a copper mine.

In 2016, after an extensive environmental review process which included public input and scientific analysis, the Forest Service concluded sulfide ore copper mining could result in, and I quote, "extreme, serious, and irreparable harm" in the watershed of this wilderness area, putting the entire ecosystem at risk.

My colleagues may say this is safe because of the legacy of taconite mining the region is used to in the Iron Range, and the fact that sulfide ore copper mining is a completely different form

of mining. It would create sulfuric acid, otherwise known as battery acid drainage, miles from the river that flows into the Boundary Waters. This risks acid drainage into the watershed, which would cause permanent damage to the ecosystem.

That should have been the end of the debate; but of course, it was not. As soon as President Trump came into office, the administration ignored the science and the input from the community, and reinstated the Twin Metals leases. But to no surprise, the Department of the Interior solicitor, under the current administration, found that President Trump improperly renewed these leases with inadequate NEPA analysis, and canceled them once again. After yet another thorough review and rounds of community input and tribal consultation, the current Administration finalized 20-year protections for the 225,000 acres around the wilderness area, making the area ineligible for mining.

Now, we are seeing today a proposal to use a clause of the Federal Land Policy and Management Act, or the FLPMA, that is widely accepted as unconstitutional to try to overturn the withdrawal. In fact, even the National Mining Association has argued the provision's unconstitutionality in court. Under this legislation, no challenge to the leases or permits could be heard ever, no matter how dire the harm to clean water, clean air, endangered species, or the people who live there.

You will see today that choosing to protect this wilderness area and its critical watershed will hurt our country's ability to meet the mineral needs of our clean energy future. But this is a false choice. If we are going to build a sustainable mining industry—and we must—we need to do so respecting sound science and community input, including tribal consultation and process. In this case, years of process have led again and again to the decision that this type of mining in this place is not worth the risk.

I look forward to hearing from today's witnesses. Thank you all for traveling all this way to be with us here in DC, and I yield back.

Mr. STAUBER. Thank you very much. I will now introduce our witnesses.

The first witness is the Honorable Tom Bakk, who is a retired Minnesota Senate Majority Leader from Cook, Minnesota; Dr. Harvey Thorleifson is a Professor of Earth and Environmental Sciences from the University of Minnesota in Minneapolis; Ms. Becky Rom is the National Chair of the Campaign to Save the Boundary Waters in Ely, Minnesota; and Mr. David Chura serves as Board Chair for Jobs for Minnesotans from Duluth, Minnesota.

I will now recognize Senator Bakk for his opening statement.

STATEMENT OF THE HON. THOMAS BAKK, MEMBER OF MINNESOTA SENATE (RETIRED), COOK, MINNESOTA

Mr. BAKK. Thank you, Chairman Stauber, Ranking Committee Member Ocasio-Cortez, and members of the Committee. Thank you for the opportunity to testify today. My name is Tom Bakk, I am a lifelong resident of northeastern Minnesota, and a very proud, what we describe up north as an Iron Ranger.

I care very deeply about the issue we are discussing this morning because I proudly represented the communities of northeastern

Minnesota in our State Legislature for nearly three decades. As a Democrat for 26 years, as the DFL Caucus Leader for 9 years, and as an independent for the final 2 years of my service, to say I am passionate about protecting the well-being of our region for current and future generations is an understatement. That is why I was deeply disappointed when the Biden administration placed a 20-year ban on mining on 225,000 acres of land in northeastern Minnesota earlier this year, in my former legislative district.

I questioned whether this Administration realized that this area contains vast quantities of critical minerals it needs to accomplish its own energy transition goals. I questioned if they knew that multiple companies are pursuing responsible development of those very resources. And I questioned if they knew our region has been on sharp economic decline for decades, and that the potential high-paying union jobs from mining are desperately needed. Surely, they must have known that locking up a domestic treasure trove of minerals only increases our reliance on sourcing metals from foreign adversaries; countries, I might add, who don't protect workers in the environment like we proudly do here in the United States.

Unfortunately, I don't believe they took any of that into consideration. For that reason, I jumped at the opportunity to come here today to encourage the Biden administration and this Committee to correct course on this harmful decision. I am also eager to share the story of why northeastern Minnesota is so unique.

Iron Rangers are hardworking, largely blue collar, very proud Americans, because we have made our contribution to the state, to the country, and to the world. The American tanks, airplanes, battleships, aircraft carriers that helped the United States win the Second World War didn't come out of thin air; they were made from iron produced by our hardworking miners on the Iron Range in northern Minnesota. Electric cars, advanced military technologies, energy storage systems to cell phones in your pockets, the copper wiring that allows us to turn the lights on every day, these are all made from the critical minerals that are abundant underground in Minnesota.

Perhaps one of the most exceptional things about our region is its natural beauty. Those of us that live in northeastern Minnesota want to protect our stunning lakes, rivers, wildlife, and woods that allow avid outdoorsmen like me to fish, hunt, and recreate outdoors year-round. When it comes to mining, it is not an either-or proposition. We can mine and protect our environment at the same time, despite the misinformation you may hear from anti-development activists. In fact, I have seen firsthand how the iron mining industry has allowed our outdoor economy to thrive for more than 140 years, and the water in northeastern Minnesota is among the cleanest in the whole state.

As I look back on three decades that I spent in the Minnesota Legislature, I am most grateful for the relationships I forged across party lines in order to find the best solutions for the common good. I worry that we have lost the ability to do that in recent years. And sadly, what is happening to proposed mining projects in Minnesota is an alarming example of that polarization.

On one hand, the Administration has set an aggressive agenda for producing clean energy here in the United States for shoring up domestic mineral supply chains and for creating American jobs. On the other hand, the same Administration removed from consideration 95 percent of our nation's nickel resources, 90 percent of our cobalt, and a third of our copper. It is extremely counterproductive to simply say no to domestic mining in a knee-jerk fashion, instead of allowing all stakeholders to evaluate projects based on their merits and to determine the best outcome. These short-sighted actions are driven by a small group of the loudest voices with much influence, rather than allowing the experts at our agencies to lead an objective process that includes public input.

I commend Congressman Stauber's work to overturn the mineral withdrawal in northeastern Minnesota to correct course on an arbitrary, detrimental decision. I fully support Concurrent Resolution 34, which will allow mining projects in the region to be fairly reviewed through an established regulatory process. It is what the people of northern Minnesota expect and deserve.

I look forward to your questions. Thank you.

[The prepared statement of Mr. Bakk follows:]

PREPARED STATEMENT OF SENATOR TOM BAKK, RETIRED—FORMER MEMBER AND LEADER OF THE MINNESOTA STATE HOUSE AND SENATE, 1995–2023

ON CONCURRENT RESOLUTION 34

Thank you for the opportunity to provide testimony regarding the consideration of House Concurrent Resolution 34. I care very deeply about the issues related to this resolution, because I proudly represented the communities of northeastern Minnesota in our state legislature for nearly three decades, as a Democrat for 26 years, as the DFL Caucus leader for nine years, and as an Independent for the final two years of my service. To say I am passionate about protecting the well-being of our region for current and future generations is an understatement.

That's why I was deeply disappointed when the Biden Administration placed a 20-year ban on mining on 225,000 acres of land in northeast Minnesota earlier this year in my former legislative district. I wondered if the administration realized that this area contains vast quantities of the critical minerals it needs to accomplish its own energy transition goals, or that multiple companies are pursuing responsible development of those resources. I wondered if they knew our region has been on a sharp economic decline for decades and that the potential high-paying union jobs from mining are desperately needed.

Surely, they must have known that locking up a domestic treasure trove of minerals only increases our dangerous reliance on sourcing metals from foreign adversaries who don't protect workers and the environment like we proudly do here in the U.S.

Unfortunately, I don't believe they took any of that into consideration.

For that reason, the opportunity to submit this testimony is incredibly important to me. I strongly encourage the Biden Administration and this committee to correct course on this harmful decision. Additionally, I want to highlight why northeast Minnesota is so significant and unique.

The American tanks, airplanes, battleships, and aircraft carriers that helped the U.S. win the Second World War weren't made out of thin air. They were made from the iron produced by our hardworking miners on the Iron Range in Minnesota.

Electric cars, advanced military technologies, energy storage solutions, cell phones and the copper wiring that allows us to turn on the lights every day are made from the critical minerals that are abundant underground in Minnesota.

Perhaps one of the most exceptional things about our region is the natural beauty. Those of us that live in northeast Minnesota want to protect our stunning lakes, rivers, wildlife and woods that allow avid outdoorsmen like me to fish, hunt and recreate outdoors year-round.

When it comes to mining in Minnesota, it is not an either/or proposition. We can mine and protect our environment at the same time, despite the misinformation promoted by anti-development activists. In fact, I've seen firsthand how the iron mining

industry has allowed the outdoor economy to thrive for more than 140 years, and the water in northeast Minnesota is among the cleanest water in the whole state.

I firmly believe we can advance a responsible copper-nickel-cobalt mining industry in the region while continuing to strictly protect our natural resources we so cherish, in large part because Congress, the Minnesota Legislature, state and federal government agencies, environmental groups, mining and exploration companies, and mineral owners have spent decades conducting the research, working on laws and regulations, and establishing the permitting processes to assure that development of non-ferrous minerals in Minnesota will be managed responsibly.

It is also paramount to remember that the nearby wilderness area, the Boundary Waters Canoe Area Wilderness (BWCAW), is already well-protected because of a significant decision made by Congress decades ago that established and banned industrial activities within the wilderness area. At the same time, Congress designated lands outside the BWCAW in the Superior National Forest where mining and other industrial activities were deemed desired conditions. Furthermore, both state and federal buffer zones were established around the wilderness area to allow access and provide additional protection.

Companies with proposed mining projects aren't asking for special treatment. They are asking for their plans to be scientifically reviewed through the fair process as outlined under law through the National Environmental Policy Act. When the environmental and permitting process works well, U.S. scientists thoroughly test a mine plan and our agencies engage all stakeholders and the public to make a project the safest and best possible.

The people of northern Minnesota will accept if the Biden Administration thoroughly reviewed proposed mine plans and decided against them because they are too risky. But because of the 20-year mining ban, the administration won't even consider a mine plan. That isn't fair to my neighbors and friends.

For the past 40 years, communities in northeast Minnesota have experienced a decline in population by about 26%.[1] Several companies have poured millions of dollars of investment into trying to advance high-tech, best-in-class mining projects that would bring thousands of good-paying full-time and spinoff jobs to the area. That's exactly the kind of economic comeback our region needs, yet the federal government doesn't seem to care. It touts goals that sound impressive on the surface while turning its back on communities like ours.

On the one hand, the administration has set an aggressive agenda for producing clean energy here in the U.S., for shoring up domestic mineral supply chains and for creating American jobs. On the other hand, that same administration removed from consideration approximately 95% of our nation's nickel resources, about 90% of our cobalt, and a third of our copper.

According to the Minnesota Department of Natural Resources, the estimated state, federal, and private mineral resources within the withdrawal area are significant: 88 billion pounds of copper, 27 billion pounds of nickel, 1.6 billion pounds of cobalt, 22 million ounces of platinum, 54 million ounces of palladium, 11 million ounces of gold, and 338 ounces of silver.[2] Developing these minerals would directly support the administration's goals on clean energy, supply chains and jobs. A domestic source of these resources is also absolutely critical to our national security.

Let me highlight the significance of those numbers with a couple of examples. The average electric car battery contains about 80 pounds of nickel, which means that because of the mineral withdrawal, the administration has stripped the U.S. of the potential to make more than 337 million electric vehicles—more than enough for each person in the country. The average single-family home uses about 440 pounds of copper for electricity, so our ability to bring power to more than 200 million homes is lost because of the mining ban. With the global average household at five people,[3] that's more than enough copper to bring electricity to the entire world population that currently has no access to power.[4] I highly doubt that the administration took the time to consider these missed opportunities.

---

[1] https://worldpopulationreview.com/states/minnesota-population

[2] https://www.lcc.mn.gov/lpsfc/meetings/170823/MN%20DNR%20Soping%20Comments_Federal%20Minerals%20Withdrawal%208_17_17.pdf

[3] https://www.pewresearch.org/short-reads/2020/03/31/with-billions-confined-to-their-homes-worldwide-which-living-arrangements-are-most-common/#:?:text=Around%20the%20world%2C%20the%20average,)%20and%20Europe%20(3.1).

[4] https://ourworldindata.org/energy-access#:?:text=work%20on%20Energy-,Summary,not%20have%20access%20to%20electricity.

Simply saying "no" to domestic mining instead of allowing all stakeholders to evaluate projects based on their merits to determine the best outcome is counter-productive to achieving our goals. It's driven by a small group of the loudest voices, with much influence, rather than allowing the experts at our federal and state agencies to lead an objective process that includes public input.

One of the most disappointing things I learned after hearing that the Department of the Interior enacted the 20-year mineral withdrawal was that the environmental assessment conducted by federal agencies to make the mining ban determination was based on purely hypothetical situations. No environmental or project-specific data from companies like Twin Metals Minnesota or others was used to support its conclusions. This means that the government didn't consider the best information available to determine whether mining can be done safely in the region. The Environmental Assessment they released even acknowledges that any of the hypothetical impacts they came up with could be mitigated, avoided, or regulated to occur under the standards set forth by state and federal agencies. Why don't our agencies recognize their own authority to oversee and implement environmental regulations rather than undermine trust in their own scientific experts' ability to get it right? It just doesn't make sense.

Ultimately, this mineral withdrawal shuts out major opportunities for America. This comes at a time when, according to the U.S. Geological Survey's 2023 Minerals Commodity Summaries report,[5] the U.S. has reached a record high for U.S. mineral imports. Meanwhile, China is and will continue to be the leading supplier for most of the minerals our economy depends on. That begs the question: Who do we trust more to develop mineral resources in a way that is respectful of the environment and workers—China or the U.S.?

As I look back on the three decades I spent in the Minnesota legislature, I'm most grateful for the relationships I forged across party lines in order to find the best solutions for the common good. I worry that we've lost the ability to do that in recent years, and sadly, what's happening to proposed mining projects in Minnesota is an alarming example of that polarization.

It's time we come to our senses and realize that everything that sustains life is either grown or mined. If we want to maintain our standard of living and ensure a cleaner future, we must have mining. And we should be demanding that those minerals be mined here in the U.S., where we can properly enforce strong labor and environmental standards.

I commend Congressman Stauber's work to overturn the mineral withdrawal in northeast Minnesota and to correct course on an arbitrary, detrimental decision. I fully support Concurrent Resolution 34, which will allow mining projects in the region to be fairly reviewed through the established regulatory process. It's what the people of northern Minnesota expect and deserve.

Mr. STAUBER. Thank you for your testimony, Senator.

I will now recognize Dr. Thorleifson for 5 minutes.

STATEMENT OF HARVEY THORLEIFSON, PROFESSOR, DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES, UNIVERSITY OF MINNESOTA, MINNESOTA

Dr. THORLEIFSON. Good morning, Mr. Chairman, Madam Ranking Member, and members of the Subcommittee. My name is Harvey Thorleifson. I am a University of Minnesota professor. I hold degrees in geoscience and biology. My first employment in science was in aquatic ecology, and much of my career has focused on protection of water. I also have engaged in research to support the mining industry, and I have held leadership positions such as chair of the State Mining Society. Today, I speak as Chair of the Minnesota Center for Mineral Resource Education, which seeks to share information to support good decision-making by society.

---

[5] https://pubs.er.usgs.gov/publication/mcs2023

I believe that we all want the same thing: for people to be healthy, wealthy, and safe, while protecting our human and natural heritage.

We need services, infrastructure, food, energy, water, and minerals, including materials needed for national security and green energy. But, as for other industries, past little-regulated mining left a legacy of landscape modification and pollution that we no longer tolerate. And although technology has advanced, we still are disturbed when we hear of tailings dam failures or acid drainage. We, therefore, are committed to reduce, reuse, and recycle.

But that is not enough. We still need to mine somewhere. But reliance on imports makes us vulnerable to supply, causes lost jobs and revenue, and condones labor and environmental practices overseas. We, therefore, benefit from domestic mining that fully satisfies all rigorous regulatory requirements.

In Minnesota, we value our clean air and water, we treasure our landscape, and we have benefited from industries. Mining is part of the Minnesota way of life, whether sand and gravel or crushed stone in every county, or iron ore for the needs of the nation. To the north in Canada are multiple major sulfide ore mines that produce needed metals that we import to the United States. The Minnesota Legislature has endorsed responsible mineral diversification and companies have been urged to explore and invest. The Duluth Complex, north and west of Lake Superior, has, therefore, been recognized as a world-class potential source of the metals that we need.

New mining offers the opportunity for jobs for Minnesota families, much revenue, and decreased reliance on imports to the United States. However, the people of Minnesota will not tolerate what they deem to be unacceptable risk, such as the potential for significant pollution of water. We are determined to protect all waters and today, in particular, we are focused on the Boundary Waters in the upper Rainy River Basin. Concern has been expressed regarding the potential for new mining in an area that drains to the upper Rainy River. There has been past mining in this drainage, and current human activity has to manage its impact, although concern has focused on acid-generating sulfide minerals.

The project that has been proposed in this area would have no pit, no headframe, no smelter, no smokestack, no long-term waste rock pile, no tailings pond nor tailings dam, but rather what has been indicated to be non-acid-generating dry stack tailings. We thus need to reconcile concern with the project as described, should further rigorous review confirm this lack of impact.

In closing, mining in this watershed could result in jobs and metals needed by the nation, and a much lower chance of pollution than past mining. I urge those who seek to facilitate or prevent this mining to more explicitly describe the pollution they believe could plausibly occur as we ensure that there is a full discussion and analysis.

In conclusion, the people of Minnesota are determined to protect the Boundary Waters, and there is concurrently recognition of the benefits that well-regulated mining can provide for the region and

for the nation, and the need to rigorously review a proposal that companies were urged to develop.

I have appreciated this opportunity to testify. Thank you.

[The prepared statement of Dr. Thorleifson follows:]

PREPARED STATEMENT OF L. HARVEY THORLEIFSON PH.D., P.GEO., D.SC.,
UNIVERSITY OF MINNESOTA PROFESSOR;
and
CHAIR, MINNESOTA CENTER FOR MINERAL RESOURCE EDUCATION

ON CONCURRENT RESOLUTION 34 AND H.R. 3195, "SUPERIOR NATIONAL FOREST RESTORATION ACT"

Good morning, Mr. Chairman, and Members of the Subcommittee. My name is Harvey Thorleifson. I am a University of Minnesota Professor, and I hold degrees in geoscience and biology.

My first employment in science was in aquatic ecology, and much of my career has focused on protection of water. I also have engaged in research to support the mining industry, and I have held leadership positions, such as chair of the state mining society.

At present, I am chair of the Minnesota Center for Mineral Resource Education, which seeks to share balanced information with the public.

I believe that we all want the same thing, for people to be healthy, wealthy, and safe, while protecting our human and natural heritage. We thus need services, infrastructure, food, energy, water, and minerals, including materials needed for national security and green energy.

But, as for other industries, past little-regulated mining left a legacy of landscape modification and pollution that we no longer tolerate. And although mining technology has advanced, we still are disturbed when we hear of tailings dam failures, or acid drainage.

We are committed to reduce, reuse, and recycle, but that is not enough, we still need to mine, somewhere. Reliance on imports makes us vulnerable to supply, causes lost jobs and revenue, and condones labor and environmental practices overseas. We therefore benefit from domestic mining that fully satisfies all rigorous regulatory requirements.

In Minnesota, we value our clean air and water, we treasure our landscape, and we have benefited from industries. Mining is part of the Minnesota way of life, whether sand and gravel or crushed stone in every County, or iron ore for the needs of the Nation.

To the north in Canada are multiple major sulfide mines that produce needed metals that we import to the US.

The Minnesota Legislature has endorsed responsible mineral diversification, and companies have been urged to explore and invest.

The Duluth Complex north and west of Lake Superior thus has been recognized as a potential source of metals, including critical minerals.

New mining offers the opportunity for thousands of jobs for Minnesota families, much revenue, and decreased reliance on imports to the US. However, the people of Minnesota will not tolerate what they deem to be unacceptable risk, such as the potential for significant pollution of water.

Counties and Tribes in the north want to protect all waters, and today we are focused on the Boundary Waters in the upper Rainy River basin.

Concern has been expressed regarding the potential for new mining in an area that drains to the Rainy River. There has been mining in this drainage, and activity presumably discharges wastewater, but concern relates to acid-generating sulfide minerals.

The project that has been proposed would have no headframe, no smelter, no smokestack, no waste rock, no tailings pond, nor tailings dam. It thus is difficult to reconcile the level of public concern with the project as described.

Mining in this watershed thus could result in jobs, and metals needed by the Nation, with a much lower chance of pollution than past mining.

I urge those who seek to facilitate or prevent this mining to more explicitly describe the pollution that could plausibly occur.

There is clear support to protect the Boundary Waters, either from significant pollution or any pollution, and no doubt people of Counties and Tribes who live in other watersheds yearn for a similar level of protection.

I have appreciated this opportunity to testify.

Mr. STAUBER. Thank you, Dr. Thorleifson.

I will now recognize Ms. Rom for 5 minutes.

STATEMENT OF BECKY ROM, NATIONAL CHAIR, CAMPAIGN TO SAVE THE BOUNDARY WATERS, ELY, MINNESOTA

Ms. ROM. I live near Ely, Minnesota, the major gateway to the Boundary Waters Canoe Area Wilderness. I am the granddaughter of an Ely iron ore miner and the daughter of an Ely-based wilderness canoe trip outfitter. I serve as the volunteer National Chair of the Campaign to Save the Boundary Waters, a coalition of more than 400 businesses, conservation organizations, hunting and fishing groups, and youth groups like Kids for the Boundary Waters that are united to permanently protect the Boundary Waters from the risks associated with sulfide ore copper mining.

I support Secretary Haaland's order banning mining of public minerals on Federal lands in the headwaters of the Boundary Waters. I strongly oppose the two House bills.

Members of the Subcommittee have heard about the sulfide ore mineral wealth of northern Minnesota. The far greater wealth is the canoe country of northeastern Minnesota and Ontario, the Boundary Waters in Canada's Quetico Park.

[Slide.]

Ms. ROM. This aerial photo is a small part of the Boundary Waters in Quetico, and it depicts the greatest canoe country wilderness in the world.

The Boundary Waters is cherished by the American people. The area has been protected by the Federal Government and the state of Minnesota for more than 120 years. The Boundary Waters became one of the nation's first wilderness areas in 1964, and every year since, more people have visited the 1.1 million-acre Boundary Waters than any other wilderness. It is America's most accessible wilderness, providing people of all abilities and income a world-class wilderness experience. And it is our nation's largest wilderness east of the Rockies and north of the Everglades. This area is 1854-ceded territory where Ojibwe people retain treaty rights to hunt, fish, and gather. Twenty-four percent of the Boundary Waters is water deemed exceptionally clean and immaculate by the Minnesota Pollution Control Agency.

Although the Clean Water Act allows no water degradation whatsoever, our canoe country wilderness would be at grave risk of permanent damage if these bills were adopted. The science is utterly clear about the pollution and destruction that sulfide ore copper mining on upstream lands and waters would do.

[Slide.]

Ms. ROM. Polluted waters would flow north into the Boundary Waters. Yet, these two bills seek to benefit one Chilean mining company, Antofagasta, to the detriment of the Boundary Waters and the American people.

The mine plan of Antofagasta's Twin Metals rejected by the BLM and shelved by the Minnesota DNR in 2022 is plain evidence of the sheer wrongness of mining in the headwaters of the Boundary Waters. The mine plan showed a toxic waste tailings storage facility on the shores of Birch Lake, directly upstream from the Boundary Waters. The plan proposed a waste storage technique

called dry stacking, which was rejected by the DNR as wrong for northern Minnesota's wet climate, and it has failed at mines elsewhere in the nation.

This mine would produce an insignificant quantity of copper, nickel, and cobalt relative to U.S. demand. Under the Antofagasta mine plan, minerals would be shipped as concentrate to a port for transport overseas for smelting. Antofagasta ships its metal concentrates from its current mines to low-cost smelters in China. By contrast, the proposed mine would cause enormous damage to the ecosystem, the landscape, and the regional economy. The benefits go to China and Chile; the harm and cost would go to America's lands and people.

[Slide.]

Ms. ROM. This is the Twin Metals mine site: 30 businesses are directly in the path of pollution of an Antofagasta Twin Metals mine. Dozens of other Boundary Waters businesses would be threatened.

The only peer-reviewed economic study to consider the costs and benefits over a 20-year period found that the regional economy would produce more jobs and income under the mineral withdrawal than if mining were to proceed. Twenty-three percent of property owners in the four area townships say they will leave if copper mining were developed.

Calls for a mine plan review, a process that Twin Metals has already failed, and for which it no longer has a credible mine plan, are misguided. Such a review is appropriate only for areas where significant landscape and ecological degradation is acceptable.

The environmental review process for a mine is imperfect. Studies show that such reviews are wrong 9 out of 10 times in predicting no water quality degradation. Minnesota's water quality standards were not designed for the pristine waters of the Boundary Waters. They allow mines to discharge pollution at levels that are five or six times the existing conditions on Birch Lake.

FLPMA provides the correct process for determining whether mines should be sited in valuable and vulnerable areas. The first and most important decision is this: Is this the right place for a sulfide ore copper mine?

In 2016, the Forest Service concluded that the headwaters of the Boundary Waters was the wrong place. Such a mine in this place presented an unacceptable risk of harm to the Boundary Waters, and would result in damage that could not be mitigated or fixed. The 2022 Superior National Forest Mineral Withdrawal EA substantiates and validates this decision and the withdrawal order.

I call on this Subcommittee to put the interests of the American people ahead of the interests of billionaire mining companies and overseas smelter operators. The Boundary Waters is a priceless asset of the people of Minnesota and the nation. Its clean water, healthy forests and wetlands, great array of wildlife, and world-class sport fishery are infinitely more valuable than the relatively small amount of minerals that could be extracted in the withdrawal area.

[The prepared statement of Ms. Rom follows:]

PREPARED STATEMENT OF BECKY ROM, NATIONAL CHAIR, CAMPAIGN TO SAVE THE BOUNDARY WATERS ELY, MINNESOTA

ON CONCURRENT RESOLUTION 34 AND H.R. 3195, "SUPERIOR NATIONAL FOREST RESTORATION ACT"

Introduction

I support Public Land Order 7917, which withdrew 225,504 acres of public lands and minerals located in the headwaters of the Boundary Waters Canoe Area Wilderness (Boundary Waters) in the Superior National Forest (Withdrawal Area) from the federal mineral leasing program for 20 years (Withdrawal Order). I strongly oppose House Congressional Resolution 34 and H.R. 3195.

Overview of the significance and logic of the Superior National Forest Mineral Withdrawal (Public Land Order 7917); the extraordinary importance of the Boundary Waters, the Withdrawal Area, and the water; and the threat posed by sulfide-ore copper mining.

The Boundary Waters is the most heavily visited Wilderness in the National Wilderness Preservation System—a distinction it has held every year since the Wilderness Act passed in 1964. At 1.1 million acres, it is the largest Wilderness east of the Rocky Mountains and north of the Everglades. The Boundary Waters is the only large lake-land Wilderness and the most family-friendly Wilderness in America. It offers unmatched fishing, hunting, and recreational opportunities for all Americans. The Boundary Waters significantly contributes to more than 22,000 jobs and $1.4 billion in tourism economic activity in northern Minnesota alone. It is at the heart of a diverse and stable economy in a huge swath of northern St. Louis, Lake, and Cook Counties.

The Superior National Forest is a well-managed and immensely popular national forest in which many thousands of people live, work, and play. Converting national forest lands in the Withdrawal Area to single use—an industrial mining district stretching many thousands of acres—would seriously, perhaps fatally, unbalance that sustainable economic-residential-recreational region. Few would wish to live or play in the vicinity of a vast industrial operation that degrades the heart of the Superior National Forest.

Congressional Resolution 34 and H.R. 3195 risk the Superior National Forest—including the Withdrawal Area; the 220,000-acre Mining Protection Area created by the Boundary Waters Canoe Area Wilderness Act of 1978 which protects three entry corridors; and the Boundary Waters. These areas together are referred to hereinafter as Protected Areas. The two bills also risk the downstream areas of Ontario's 1.1 million-acre Quetico Park and the 218,000-acre Voyageurs National Park.

The Protected Areas encompass a water-dominated northern landscape unique in America's public lands inventory; they hold ecological, social, and economic significance of continental and worldwide importance. The Withdrawal Area encompasses the federal lands and minerals lying within the Rainy River Headwaters subwatershed. The Rainy River Headwaters forms the major portion of the headwaters of the Boundary Waters. The Protected Areas were greatly at risk of, and remained unprotected from, sulfide-ore copper mining pollution and defilement until the Withdrawal Order. Without the Withdrawal Order, the Boundary Waters would be at risk of devastating and irremediable water pollution by acid, heavy metals, and sulfates; 80.1% of the Boundary Waters lies within the Rainy River Headwaters, downstream of the areas in the Headwaters where Antofagasta of Chile and other companies sought to mine copper and other sulfide-ore minerals. Further, aquatic and terrestrial ecosystem destruction from mine development on the periphery and upstream of the Boundary Waters would have unpreventable spillover effects into the Wilderness. Frank Ongaro, the former executive director of Mining Minnesota, a copper mining industry group, admits that mining causes major damage. "*Mining by its nature and scale causes significant changes in the landscape and ecosystem*." (*Successful Non-Ferrous Mining: Promise or Reality*, Eger, P. and Ongaro, F., 2014). Sulfide-ore copper mining in the Rainy River Headwaters would require ongoing maintenance and remediation for 500+ years to mitigate, if even possible, such mining's inevitable pollution of the waters of the Protected Areas.

Federal lands in the Withdrawal Area are managed for a variety of compatible, sustainable, non-exclusive uses. The Withdrawal Order protects lands in the Withdrawal Area and their multiple compatible uses, as well as the Boundary Waters and other Protected Areas, from the greatest threat they have faced. The 2022 Superior National Forest Mineral Withdrawal Environmental Assessment documents both the high risk of long-lasting environmental damage to forests and waters by sulfide-ore copper mining pollution and the impossibility of prevention

and mitigation of such pollution in this fabulously water-rich environment. Proposals to develop sulfide-ore copper mines (including four deposits targeted by Antofagasta's Twin Metals) within the Rainy River Headwaters threatened this unique Wilderness, other Protected Areas, other parts of the Superior National Forest, and their enormous ecological, social, cultural, and economic values. The Boundary Waters and the other Protected Areas are highly vulnerable to sulfide-ore mining and acid mine drainage because of the abundance of water, the massively interconnected surface water and groundwater, and the low buffering capacity of the waters. Twenty percent of all freshwater in the entire 193-million-acre National Forest System is in the Superior National Forest. These waters are among the cleanest in America.

The Duluth Complex geological formation underlying northeastern Minnesota contains only trace amounts of copper and other metals (less than one percent). As a result, enormous quantities of sulfide-bearing waste rock, polluted process and contact water, and tailings would be generated if mining were to occur. Peer-reviewed science published in the Journal of Hydrology shows that pollution from sulfide-ore copper mining in the Withdrawal Area would enter the waters of the Boundary Waters, which are designated Prohibited Outstanding Resource Value Waters (the highest level of protection afforded in Minnesota's federal-compliant anti-degradation rules). Meyers, *J. Hydrology* 533:277–290. Pollution from sulfide-ore copper mines would cross the international boundary and damage Quetico, one of Canada's premier wilderness parks, and, farther downstream, Voyageurs.

The Boundary Waters and the rest of the Superior National Forest are within the 1854 Treaty Ceded Territory; the Grand Portage, Bois Forte, and Fond du Lac Bands of Lake Superior Chippewa (Bands) have treaty rights to hunt, fish, gather, and conduct cultural practices that depend on protecting the land and existing water quality. All federal agencies share in the federal government's trust responsibility to the Bands to maintain those treaty resources.

Interior Secretary Deb Haaland's Withdrawal Order is an essential first step toward permanent protection. Secretary Haaland's decision to protect the Boundary Waters by prohibiting mining on federal lands upstream from the heart of the Wilderness for 20 years—the maximum allowed under current law—was based on thorough analysis. The Environmental Assessment (EA) released with the Withdrawal Order details the impact of sulfide-ore mining on land, water, and wildlife; the potential harm to Native American communities, treaty rights, and resources; and the climate change implications resulting from the destruction of forest land and the vast consumption of energy by mining operations.

The EA underlying the Public Land Order reflects intense awareness of the value of the public assets at risk; it states "[t]he Boundary Waters Canoe Area Wilderness is a complex and interconnected ecosystem and offers recreational opportunities and other uses such that it is considered an irreplaceable national treasure." The Minnesota Pollution Control Agency is of the same mind; in its 2017 water quality assessment of the Rainy River Headwaters, which includes the Withdrawal Area, the MPCA describes the waters as "immaculate" and states "[t]he majority of the waterbodies . . . had exceptional biological, chemical, and physical characteristics that are worthy of additional protection."

Personal Background

My name is Becky Rom. I live a few miles north of Ely, Minnesota. I grew up in Ely as the daughter of a wilderness canoe trip outfitter and the granddaughter of an iron ore miner. Now a mother and a grandmother, I serve as the volunteer National Chair of the Campaign to Save the Boundary Waters, a coalition of more than 400 businesses, conservation organizations, and hunting and fishing groups that are united to permanently protect the Boundary Waters from the pollution and destruction that inevitably result from sulfide-ore copper mining. Our organization is headquartered in Ely and is led by people of northeastern Minnesota.

My dad was Bill Rom, who, after serving as a naval officer in the Pacific in World War II, founded a wilderness canoe trip outfitting business (1946–1976) in Ely. For most of that time, Dad, Mom, my three brothers, and I lived in an apartment over the outfitting business, which was open from May 1 to October 1, 7 days a week, 6 am to 10 pm. The business was my family's life and everything revolved around it. Thousands of people came to my dad's business, Canoe Country Outfitters, during the summers. Daily conversations with canoe trip customers led me to appreciate the uniqueness and value of the wilderness. Returning from Boundary Waters trips, they wanted to share their experiences and talk about it all. They viewed the canoe country as an extraordinary gift.

When my parents could escape from work, we ventured into the Boundary Waters. My first canoe trip was at the age of two. My brothers and I were trained

as canoe trip guides; we spent many weeks in the canoe country each year. My first guiding trip was at the age of 14, at a time (1963) when girls did not customarily work as wilderness guides.

In April 1967, the last hematite mine in Minnesota, the underground Pioneer Mine in Ely, closed forever and mining ended in our community. Over the past 50+ years, many people have moved to the Ely area because of the canoe country. It is a great place to live, to have the wilderness next door, to be able to venture out into it during all seasons and weather. Most of the people who live in northeastern Minnesota favor protection of the canoe country and are opposed to sulfide-ore copper mining in the Boundary Waters watershed. Polling shows that nearly 70% of Minnesotans support a permanent ban, and within Congressional District 8, my district, residents oppose mining near the Boundary Waters by a ten-point margin.

The Boundary Waters Canoe Area Wilderness

The Boundary Waters is 1,719 square miles of lakes, streams, forests, and wetlands in Northeastern Minnesota. It is part of the great Quetico-Superior ecosystem, a wild 4.3-million-acre landscape that straddles the border of Minnesota and Ontario. This is the greatest canoe country wilderness on the planet. It is a watery, wildlife-rich paradise. All surface waters from the headwaters of the Boundary Waters flow to Hudson's Bay, coursing through the Boundary Waters, the Quetico, and Minnesota's Voyageurs National Park before turning north at Lake of the Woods. The waters are exceptionally clean—'immaculate' in the words of the Minnesota Pollution Control Agency. One can safely drink out of the lakes in the Boundary Waters. And the water is abundant. The Boundary Waters sits within the 3-million-acre Superior National Forest; the Superior contains 20% of the freshwater in the entire 193-million-acre National Forest System. The Boundary Waters itself is 24% freshwater. It is wild country—home to wolves, lynx, moose, loons, warblers, eagles, and countless other creatures—it is the only place in the lower 48 states where wolves were never extirpated. The forest of pine, spruce, cedar, and birch sits on a shallow layer of soil atop granite and other igneous rock. Lakes were carved into this Canadian Shield by glaciers. Travel today is by canoe or dogsled, on boots, skis, or snowshoes, much as the Anishinaabe and the fur-trading voyageurs traveled along the border lakes and then north. **Attachment 1** shows a portion of the Boundary Waters and Quetico.

Nothing else in our National Parks or our National Wilderness Preservation System is like the Boundary Waters. It is utterly unique. Nowhere else is there such a seemingly endless network of lakes, streams, and wetlands—all connected by portage trails through a boreal forest landscape. No other Wilderness is so accessible to people of all ages and abilities—babies in diapers can travel with their parents by canoe in the Boundary Waters. My own babies did. Elderly people and others with physical challenges can, with assistance, spend days traveling by canoe and camping in the Boundary Waters. These are among the reasons that the Boundary Waters is the most-visited Wilderness area in America. There is no other place like this. We cannot and will not allow sulfide-ore mining in its watershed.

The Sulfide-ore Copper Mining Threat to the Boundary Waters

The Duluth Complex is a massive body of sulfide-bearing ore that underlies much of the Superior National Forest, including the Boundary Waters, and extends south to Lake Superior. Trace amounts of copper, nickel, platinum, and palladium (in total less than 1%) are found in this low-grade ore body. Mining of the Duluth Complex, which has never been done, would present massive environmental risks. The sulfide-bearing ore would generate acid mine drainage. Mine infrastructure would destroy thousands of surface acres in the Superior National Forest in one of the most vibrant regions of recreation and economic activity in northern Minnesota.

Sulfide-ore copper mining has never been done in Minnesota—this is not the same as my grandfather's hematite mining or taconite mining in the Mesabi Iron Range. Sulfide-ore copper mining poses a unique threat because the ore contains metals bound together with sulfur. When exposed to air and water, sulfide-bearing ore discharges acid mine drainage into ground and surface waters (sulfuric acid, heavy metals, and sulfates). Because there are only trace amounts of metals, the volume of waste rock and tailings (crushed ore) would be enormous. The waste rock and tailings would generate acid mine drainage for hundreds of years.

The most immediate threat had been from Antofagasta, a very large mining conglomerate from Santiago, Chile, that owns Twin Metals Minnesota and sought approvals to mine public minerals in the Superior National Forest. Antofagasta purchased Duluth Metals, a Canadian junior mining company, in January 2015, and with that acquisition gained control of Twin Metals and two expired federal mineral

leases. The four deposits—two shallow and two deep—are adjacent to the Boundary Waters and along rivers and lakes that flow into the Wilderness.

If the Twin Metals mine plan were ever developed, acid mine drainage would flow from a tailings dump located on a 640-acre site owned by the State of Minnesota on the shores of Birch Lake into the waters that flow into the Boundary Waters. This toxic pollution from the tailings dump and underground pollution from the mine would flow into waters that are clean and very low in alkaline, meaning the waters have little capacity to buffer the acid generated by this type of mining. Scientific evidence of significant and permanent harm to the Boundary Waters is overwhelming and not credibly contradicted. The Forest Service has concluded that the inevitable damage to the Boundary Waters could not be mitigated or fixed. **Attachments 2 & 3 show the flow path of water and the path of pollution in the Rainy River Headwaters**.

The Sulfide-Ore Copper Mining Threat to the Boundary Waters Economy

Pro-Twin Metals boosters claim that copper mining would bring new jobs—but in fact the cost to the regional economy would far outweigh any alleged economic benefit of copper mining in the watershed of the Boundary Waters. Furthermore, underground mining is rapidly undergoing a major transformation. Anglo American, a large copper mining company that employed 87,000 miners worldwide at the time, said in 2017 that mines of the future will be fully automated and the only local people to be employed would in community relations addressing the lack of local jobs in mining.

The endless mantra that sulfide-ore mines will provide jobs is an attempt to mask the negative long-term economic impact if such mining were allowed to occur next to the Boundary Waters. The vast percentage of the jobs would be temporary construction work lasting a year or two and filled by workers from far-flung places—not local communities. But the destruction of thousands of acres of land for mine infrastructure would be permanent, and it would definitely be local. That destruction and mining's water pollution would result in irreversible harm to the Boundary Waters watershed ecosystem. The current sustainable outdoors-oriented economy of Northeastern Minnesota would be devastated. The only peer-reviewed study of the economic impact of copper mining in the region was conducted by economists at Harvard University and concluded that over a period of 20 years both jobs and income in the Boundary Waters region would be higher if mining does not occur.

The mineral withdrawal will lead to a far better outcome for the region economically, resulting in more jobs and more income over 20 years. In the peer reviewed and published study "Analysis of proposed 20-year mineral leasing withdrawal in Superior National Forest," *Ecological Economics*, March 2020, prominent Harvard economics professor James Stock compared the effects of the Forest Service's proposed 20-year mining ban near with the consequences of sulfide-ore copper mining in the Boundary Waters watershed. The conclusion: protecting public lands near the Boundary Waters from sulfide-ore copper mining generates greater long-term gain for the region (more employment and more income) than copper mining.

The study compared two scenarios: Scenario 1—The Boundary Waters economy continues to develop during a 20-year mining ban; Scenario 2—The mining ban does not occur, and a Twin Metals/Antofagasta mine is developed. The study projected 36 employment and 72 income scenarios representing a range of employment and income effects over a 20-year period. The analysis showed that mining would likely have a negative effect on the regional economy in both employment and income because of the negative impact of mining on the recreational industry and on in-migration. The findings highlighted the important of considering the long-term effects of resource extraction in natural-amenity-rich areas. The preponderance of the scenarios (89%) found fewer jobs and less income resulting from a mining project, meaning that an economy based on copper mining would significantly underperform the existing growing, sustainable economy. This is the only economic study to analyze the longer-term dynamic economic effects of the two options over a 20-year timeframe.

In their 2017 report, "Sulfide-Ore Copper Mining and/or A Sustainable Boundary Waters Economy: The Need to Consider Real Tradeoffs," Drs. Spencer Phillips and Carolyn Alkire describe the key indicators of transition and economic growth in the diversifying and more stable modern economy that exists in the three-county Arrowhead region (St. Louis, Lake, and Cook Counties), which has developed in the years since the start of mining's decline in the early 1980s. In the modern Arrowhead (northeastern Minnesota) economy, amenity-based development has taken the place of mining as the engine of development in the region.

In his Feb. 27, 2018 FLPMA comment letter, Dr. Spencer Phillips says that claims of increased mining employment must be viewed in consideration of an accelerating trend of decreasing labor intensity in the mining industry.

- A new wave of automation in mining uses autonomous and remotely controlled machinery monitored by a few persons who may be located far from mining sites.
- This continuing trend means that estimates made now of the number of jobs a mine may have to offer in the future are inflated and are not likely to be local jobs for local people.
- Copper mining giant Anglo America predicts automation will make the future mining industry "unrecognizable" to people who know it now and the human employee of the future will only need to focus on managing the company's community relations.
- In contrast ". . . the mining withdrawal could save between 9,556 and 27,281 jobs."

Despite claims by mining companies to the contrary, the Withdrawal Order economically benefits the communities in and near the Withdrawal Area and the Boundary Waters, both in terms of jobs and income. Thirty businesses operate directly in the path pollution would travel from a sulfide-ore copper mine located in the Rainy River Headwaters. These businesses would not likely be able to survive if a Twin Metals mine were developed. A University of Minnesota survey of property owners in the four townships in the immediate area of the Withdrawal Area showed that 23% said they would move from the area if sulfide-ore copper mining were developed in the Headwaters.

Protecting the Water Quality in the Boundary Waters is an Overriding Principle of Minnesota State Law.

The Boundary Waters is a uniquely valuable place that should be protected from destructive sulfide-ore copper mining proposed on public lands in its headwaters. It is our nation's premier lake-land National Wilderness Area and the most visited of all such areas. A defining characteristic is water: twenty-four percent of the Boundary Waters is water, and these waters are described by the Minnesota Pollution Control Agency as extremely clean and immaculate. Minnesota has classified the waters of the Boundary Waters as "prohibited outstanding resource value waters." Minn. Rule 7050.0335, Subp. 3.A. No degradation of water quality is allowed. See **Attachment 4**. In addition, Minnesota state law mandates that water be managed from a watershed perspective.

Sparkling Clean Water—the Rainy River Headwaters. In addition to being highly valuable because of its exceptional water quality, the Headwaters, including the Boundary Waters, is uniquely vulnerable. The waters of the Boundary Waters and the surrounding Superior National Forest are vastly interconnected—lakes, rivers, streams, wetlands, and groundwater—and the extensive interconnectedness is poorly understood, meaning that water pollution could travel undetected for some indeterminate time and the route by which pollution moves—particularly through fractured bedrock—may not be decipherable. The water chemistry of the Boundary Waters and the surrounding Superior National Forest lands is poorly-buffered, i.e., low in alkaline or base compounds, meaning that newly introduced acid mine drainage would cause the pH of the waters to become acidic; alkalinity is necessary to counteract acidity. Mine drainage and deposition of air pollution from mines in the Headwaters would cause mercury contamination in fish and all who eat fish, both downstream and downwind. Acid mine drainage would cause the loss of aquatic life. Because the degraded waters would be in a vast lake-land national Wilderness Area, the damage could never be remediated, mitigated, or fixed without doing further extreme damage to the Wilderness.

Sulfide-ore copper mining has a history of pollution. The EPA has determined that the Duluth Complex, which underlies the withdrawal area, is acid-generating. It also contains very low-grade ore. Waste from mines in the Duluth Complex will be vast—roughly 99% of the ore body. Mine waste would be a source of water degradation for hundreds of years. Leachate from mines in the Boundary Waters Headwaters would include sulfates, sulfides, and heavy metals such as arsenic, copper, zinc, and other toxic metals.

The Withdrawal Order is thus essential to protecting the Boundary Waters from the ravages of sulfide-ore mining in its watershed. Half-measures will not do. The mining industry claims that modern technology will contain its toxic wastes and protect water from pollution, but every objective observer knows that is highly

unlikely to be true. A peer-reviewed report on 14 modern sulfide-ore copper mines representing 89% of current US copper production showed all 14 experienced accidental releases of pollution, and 13 of 14 (92%) copper mines experienced water collection or treatment system failures that resulted in significant water pollution. US Copper Porphyry Mines Report, Bonnie Gestring; *Earthworks*. 2012. In an update to the 2012 report, Earthworks reviewed available records reflecting the performance of 15 copper mines in the United States, the combined output of which represented essentially all (99%) of copper production in 2015 and found that 14 of the 15 top U.S. copper mines (93%) failed to capture and control wastewater, resulting in significant water quality impacts. U.S. Operating Copper Mines: Failure to Capture & Treat Wastewater, *Earthworks*. 2019.

Experts agree: Dave Chambers, a registered professional geophysicist has been reviewing the potential for mine proposals within the Duluth Complex to produce pollution, including but not only acid mine drainage (AMD), since 2009. According to Dr. Chambers:

> ". . . the Duluth Complex contains disseminated metal sulfides proven to generate acid. If built, sulfide-ore mines in the Complex have the potential to generate AMD.
>
> The risks have been well-known for decades, by the U.S. Environmental Protection Agency, Minnesota's state agencies and by mining companies. AMD is still occurring at the nearby and now-closed Dunka mine, where millions of tons of Duluth Complex rock were blasted and stockpiled and have been leaching AMD since at least the early 1970s. Despite steps taken to neutralize the acid, the Dunka mine drainage still carries sulfate and dissolved metals at concentrations hundreds of times higher than background levels for northeastern Minnesota.
>
> Water contamination from mining wastes can still be an unanticipated problem, despite all the planning involved, money spent and good intentions. There is no 100% guarantee that AMD won't cause off-site contamination.
>
> The Twin Metals deposits contain sulfides at higher concentrations than other Duluth Complex deposits and could be expected to produce the same contaminants at higher rates and concentrations, in mine drainage more likely to be acidic. Suggestions that we can guarantee the prevention of AMD do not represent the risks of AMD, and the caution that is needed to protect the Boundary Waters and its watershed.
>
> Here is a troubling fact: a 2012 review of water-quality impacts from 14 operating U.S. sulfide-ore copper mines found that 100% of the mines experienced pipeline spills or accidental releases and 13 out of 14 mines experienced failures to control contaminated mine seepage, leading to harmful water-quality impacts. Despite assurances to the contrary.
>
> In a 2019 update to the report, records reflecting the performances of 15 U.S. copper mines were examined, and it found that 14 of the top 15 copper mines (93%) failed to capture and control wastewater, resulting in significant water-quality impacts. Recently, a report of five hardrock mines in Alaska, some identified as "model" mines by Twin Metals, documented 8.150 spills from 1995 to 2020.
>
> This is the challenge with mining. Even with the best of designs and best efforts, spills and leaks happen. Mining occurs in the natural environment, not in a controlled factory. The Boundary Waters is too important to risk."
>
> Letter to the Editor, Star Tribune, June 12, 2022

Technology is indeed a slender reed upon which to rest the welfare of the Boundary Waters given the overall history of industrial accidents and technological failures that regularly beset the world: pipelines, trains, oil refineries, space shuttles, and mines. For example, in August 2014 the tailings dam at the Imperial Metals Mount Polley mine in British Columbia failed, with disastrous consequences. Just 1 year earlier, Knight-Piesold—the designer of the failed tailings dam—had this to say: "Modern dam design technologies are based on proven scientific/engineering principles, and there is no basis for asserting that they will not stand the test of time." Speaking after the Mount Polley disaster, Brian Kynoch, President of Imperial Metals, said "I apologize for what happened. If you asked me two weeks ago if this could have happened, I would have said it couldn't."

Metals from the Area Covered by the Superior National Forest Mineral Withdrawal Are Insignificant Relative to U.S. Demand and Irrelevant to National Security and the Green Economy.

Sulfide-ore copper mining in the Withdrawal Area would sacrifice the Boundary Waters while producing an insignificant quantity of metals compared to United States demand. In addition to providing only a drop in the bucket in terms of demand, the metals would be shipped out of the United States, most likely to China, for final processing, and sold on the world market. The argument that metals in the Withdrawal Area are needed for the transition to a "green" economy is not credible. So-called critical minerals do not exist there in sufficient quantities to justify irreparably damaging the Wilderness. **The amount of minerals is tiny in terms of current U.S. demand—1.5 percent as to cobalt, 3.6 percent as to nickel, and 2.3 percent as to copper (based on 2019 annual consumption).** The only viable solution for transition to a green economy is to continue to rely on our longtime and secure allies—Canada, Australia, Norway, and others—for cobalt and nickel. Looking to the watershed of the Boundary Waters does next to nothing to help in the transition. Not only is the quantity of metals insignificant in terms of U.S. demand, but also any such metals would be irrelevant because they would be shipped to China for smelting and processing and sold on the world market.

Copper. Copper is abundant throughout the world. United States and world resources are plentiful and growing. The United States is among the top copper producers in the world. The U.S. Geological Survey Materials Flow Analysis section assesses a low disruption potential for copper in the U.S. economy. The United States has only three active copper smelters. They are fully integrated, meaning the companies that own them also own their own copper mines that supply the smelters with enough concentrates to keep them operating at full capacity. Any new mine in the watershed of the Boundary Waters would send its copper (and nickel) concentrates out of the United States for processing. The Mine Plan for a Twin Metals mine, for example, called for transporting its metal concentrates to a port facility. Antofagasta, the owner of Twin Metals, sends its copper-nickel concentrates from its mines in South America to China for smelting and refining.

Nickel. The United States does not have a significant amount of nickel. Its close trading partner, Canada, is a leading supplier of nickel (and other critical minerals) to the United States. Canada has more than 28 times the nickel reserves as the United States and on average its deposits are of double or higher grade than those in the United States. Canada is also eager to supply more metals to the United States. Other major trading partners for nickel include the countries of Norway, Finland, and Australia, all of which are on the Department of Defense's Security of Supply countries (USGS OFR-1127, p. 5). The United States has no nickel smelters. As discussed above, any nickel concentrate from mining in the watershed of the Boundary Waters would be shipped overseas, likely to China, for processing.

Cobalt. A Twin Metals mine would produce a very small quantity of cobalt. Cobalt would be a by-product from smelting and refining nickel concentrates, which would be done off-shore, most likely in China. Cobalt grades in Twin Metals deposits are among the lowest of all deposits in the world and production, even if not sent abroad, would be insufficient to dent U.S. demand. At most, a Twin Metals mine might meet 1.5% of the U.S. annual demand for cobalt (based on 2019 annual consumption). As U.S. consumption rises, this percentage would decline. By contrast, the United States currently imports 57% of its cobalt needs from Canada, Norway, Japan (USGS OFR-1127, p. 29) and Finland, all close U.S. allies and trading partners. Australia alone has 83 deposits containing cobalt, 55 of which are of double or higher grade than the Duluth Complex deposits in the Boundary Waters watershed. For example, one of those deposits alone, if mined, has enough contained cobalt to supply the United States at current demand, for more than 270 years. Another Australian deposit, the currently operating Murrin-Murrin mine, has grades five times better than the best a Twin Metals mine could offer and contains 198,000 tons of cobalt, more than 42 times what a Twin Metals mine could produce. With a Twin Metals mine, the United States would sacrifice the Boundary Waters and still need to import more than 98% of its cobalt.

The United States could dramatically reduce demand for minerals by investing in a circular economy—including recycling, reuse, manufacturing improvements and substitution that would create jobs domestically while not putting places such as the Boundary Waters at risk of toxic mining. Many minerals identified as critical are discarded as waste material and are not recovered during smelting and/or refining. Stronger laws, regulations, and standards could compel the recovery of minerals from existing mines, waste, and

tailing piles, thus adding to the supply chain. It is estimated, for example, that there is as much cobalt among e-waste landfills in the eastern Unites States as in all the Democratic Republic of Congo.

A Mine Plan Review is inadequate to protect the Boundary Waters

The claim that the Withdrawal Order undercuts the regulatory review process and that only a specific mine plan should be studied ignores federal law that plainly establishes a more important process—that is, a process to determine whether any mine at all, no matter its plan of operations, should be allowed on unique, fragile, highly-valued public lands. The question is not whether a specific mine plan is clean enough; the question is whether the landscape at issue should be subjected to the destruction and disruption that are an integral part of mining. No amount of review of a mine plan would change the inevitable impact of a Twin Metals mine: significant degradation of the greater ecosystem and negative alteration of the landscape over many thousands of acres; and pollution of water, land, and air materially greater than existing conditions even if the mine were to comply with federal and state pollution standards. Repair, mitigation, or fixing of a polluted Boundary Waters is not possible. Moreover, industrial accidents happen frequently—too often at catastrophic scale. Neither would the review of a mine plan address the negative impact on the regional economy. The only peer-reviewed study on the topic found that protecting the Boundary Waters from copper mining would result in more jobs and more income over a twenty-year period.

Two peer-reviewed studies by Dr. Ann Maest and Jim Kuipers, P.E., compared predicted and actual water quality at hardrock mines, the reliability of predictions in environmental review, and the state-of-the-art methods and models of predicting water quality at hardrock mines. Among their findings was this: mine projects that are both near groundwater or surface water and possess an elevated potential for AMD or contaminate leaching—all of which is true for sulfide-ore mining in the Headwaters—are so high risk that water quality exceedances are a near certainty. This is true for 85% of mines near surface water and 93% of mines near groundwater. Of the sites that developed AMD, 89% had predicted that they would not. J.R. Kuipers et al, "*Comparison of Predicted and Actual Water Quality at Hardrock Mines: The reliability of predictions in Environmental Impact Statements*," 2006.

Antofagasta's Twin Metals has no viable mine plan. Twin Metals has no leases to mine federal minerals in the Withdrawal Area; leases issued unlawfully in 2019 without the required Forest Service consent were canceled in 2022. Although the mining company submitted a mine plan to the Bureau of Land Management (BLM) and the Minnesota Department of Natural Resources (DNR) in December 2019, the BLM rejected the mine plan and the DNR halted all consideration of the mine plan in February 2022. Twin Metals had failed to substantiate its claim that its waste ore and tailings would not be acid generating; its dry stack storage proposal was rejected by the DNR as inappropriate for northern Minnesota's wet environment (Finding of Facts and Conclusions of Law for the Northmet Project, 2018); and the proposal to store millions of tons of waste on state land on the shores of Birch Lake exposed the State of Minnesota to financial risk. In conclusion, there is no viable Twin Metals mine plan and nothing to review. See **Attachment 5**.

The Boundary Waters Can Contribute Significantly to Solving the Climate and Extinction Crisis; The Boundary Waters region is vital for carbon sequestration.

The 4.3 million-acre Quetico-Superior region is primarily boreal forest. Boreal forests store more carbon than any other terrestrial ecosystem—almost twice as much per acre as tropical forests. Keeping carbon locked in these forests and out of the atmosphere is a vital part of the fight to keep warming below 2 degrees Celsius. According to a federal government report prepared for members and committees of Congress, each acre of terrestrial boreal forest stores on average about 180 tons of carbon in its vegetation and soils. Destruction of boreal forest for industrial mining is a double whammy—the release of much of that carbon into the atmosphere and the loss of the capacity of the land to take up carbon in the future. The loss is even greater if wetlands are destroyed. Soil carbon levels in wetlands are nearly double the level in the terrestrial boreal forest.

Mechanical destruction of vegetation and soil is not the only harm that would result from permitting copper mining. The carbon storage assets of the Boundary Waters region (surface vegetation, soils, wetlands, and peatlands) are incredibly vulnerable to acid mine drainage—the water pollution that inevitably results from sulfide-ore mining.

Protecting the Boundary Waters is critical for greenhouse gas emission avoidance. An estimate of greenhouse gas emissions, based on a 2014 Prefeasibility Report for the proposed Twin Metals mine, is 23,444,730 metric tons of CO2 over a 20-year life of the mine. This is equal to greenhouse gas emissions from adding nearly five million passenger vehicles to the roads for one year.

The Boundary Waters is crucial for climate adaptation and resilience. According to climate modeling by The Wilderness Society, the Quetico Superior region is one of the 8 most important regions in the nation for climate adaptation and resiliency. It is the one remaining intact biome in Minnesota—a largescale ecosystem with clean freshwater, clean air, a healthy boreal forest, and a wide range of birds and other wildlife. The Withdrawal Public Order is an equitable outcome that respects the people who live in and visit the region, including the Bands that enjoy hunting, gathering and fishing rights by treaty. Protecting the Headwaters and the Boundary Waters is part of the solution to the climate and extinction crises and an important step on the road to environmental justice.

The climate modeling identified 74 places in the United States that are crucial to our ability to sustain biodiversity in the face of a changing climate. The analysis found that the Quetico-Superior region is one of the top places in the nation. A recent study by The Nature Conservancy with similar findings underscores the necessity of keeping these areas intact and undeveloped. Consistent with this, The Nature Conservancy, The Conservation Fund, and The Trust for Public Land have acquired large swaths of land across northern Minnesota to keep them protected. Allowing the creation of an industrial mining zone in the Headwaters of the Boundary Waters would undermine the work that these and other organizations are doing to prepare us for the future.

The views of the American People; Increased protection of the Boundary Waters from sulfide-ore copper mining has strong state support.

Most people across the state of Minnesota and across party lines support protecting the Boundary Waters from the risk of sulfide-ore copper mining.

"Minnesotans understand mining and are, in general, not anti-mining. They also understand the role of certain metals, such as cobalt and nickel, in national security and for a clean energy transition. However, Minnesotans reject as a false choice the claim that sulfide-ore copper mining in the Boundary Waters watershed is needed or even relevant. Minnesotans overwhelmingly oppose sulfide-ore copper mining in the watershed of the Boundary Waters, where it would pose a danger to the Boundary Waters. Opposition to sulfide-ore copper mining in the Boundary Waters watershed cuts across demographic, geographic, and ideological lines, making protection of the watershed a clear winner in Minnesota." **John Anzalone, IMPACT Research.**

In February 2018 Fabrizio Ward (former President Trump's pollster) found that by a 48% margin, Minnesotan voters are against sulfide-ore copper mining in areas near the Boundary Waters (70% oppose/22% favor). Opposition to sulfide-ore copper mining near the Boundary Waters extends to Congressional District 8 (CD-8), the location of the Boundary Waters and its watershed (the Rainy River Headwaters). **Most voters (56%) in CD-8 are opposed to sulfide-ore copper mining in areas near the Boundary Waters.** Voters are aware that outdoor recreation and public lands contribute greatly to Minnesota's economy. **Nearly nine in ten believe that the outdoor recreation economy, meaning people who come to hunt, fish, camp, and see wildlife, as well as those who manufacture and sell equipment for those activities, are important to Minnesota's economic future.** Furthermore, four in five voters say that due to the presence of public lands and the state's lifestyle of outdoor recreation, Minnesota has an advantage over other states in attracting good jobs and innovative companies.

In July 2020, ALG Research found that voters in Minnesota oppose sulfide-ore copper mining on the edge of the Boundary Waters by a 39-point margin (62% oppose/23% favor). Opposition to sulfide-ore copper mining on the edge of the Boundary Waters is both geographically broad and bipartisan. Democrats oppose by a 69-point margin; Independents by a 48-point margin; and Republicans by a 3-point margin. Voters in CD-8 oppose sulfide-ore copper mining on the edge of the Boundary Waters by a 10-point margin. **ALG Research found that voters overwhelmingly support permanent protection for the Boundary Waters. More than two-thirds of the voters (68%) want the Boundary Waters permanently protected from threats such as sulfide-ore copper mining.** ALG Research found that the Boundary Waters is uniquely popular among Minnesotans. The area gets a 84% favorability rating, with a notable 66% very favorable. **The**

positivity toward the Boundary Waters crosses geographic, demographic, and ideological lines and is bolstered by the view that outdoor recreation and tourism are significantly more important to Minnesota's economic future than mining (45% outdoor recreation and tourism/10% mining/35% both).

Finally, a poll conducted by Change Research of Minnesota midterm voters in November 2022 found that 7 in 10 (69%) support legislation to permanently protect the Boundary Waters from the threat of sulfide-ore copper mining.

Boundary Waters Canoe Area Wilderness: For nearly 120 years, the State of Minnesota and the federal government have worked together to protect and preserve the canoe country of Northeastern Minnesota.

In 1902, the U.S. Land Office withdrew 500,000 acres in the future Boundary Waters Canoe Area Wilderness from settlement. In 1905, General C.C. Andrews, Minnesota's land commissioner, persuaded the U.S. Land Office to withdraw from settlement 659,700 more acres in the future Boundary Waters. In 1909, President Theodore Roosevelt established the Superior National Forest of more than 1.1 million acres. Also in 1909, the Minnesota Legislature created a 1,200,000-acre statutory Superior Game Refuge, similar in area to the Superior National Forest and including most of what is now the Boundary Waters.

In 1926, U.S. Agriculture Secretary W.M. Jardine established a 'roadless area' of 640,000 acres in the Superior National Forest to "retain as much as possible of the land which has recreational opportunities of this nature as wilderness." Federal land acquisitions and boundary changes increased federal ownership to over two million acres. In 1938, the U.S. Forest Service established the Superior Roadless Primitive Area covering most of the current Boundary Waters.

Because of threats for dam building along the U.S.-Canada border, in 1930 Congress passed the Shipstead-Newton-Nolan Act to protect waters levels. Minnesota's Legislature followed suit by passing the 'Little Shipstead-Newton-Nolan Act' to provide similar prohibitions on state lands.

In 1948, Congress passed the Thye-Blatnik Act to buy out private in-holdings in what is now the Boundary Waters. The Act also provided for payments-in-lieu-of-taxes to Cook, Lake, and St. Louis Counties for certain federal lands.

In 1949, President Harry Truman issued an executive order for an air-space reservation, which prohibits airplanes flying below 4,000 feet above-sea-level over the Boundary Waters. The Minnesota Legislature passed a law to regulate aircraft and watercraft modeled after federal regulations.

The Wilderness Act became law in 1964. The Act established the National Wilderness Preservation System and designated 9 million acres of America's national forests to be Wilderness Areas. The Boundary Waters was so designated, representing 1 million of the 9 million acres. The National Wilderness Preservation System now includes 110 million acres of national public lands.

The Minnesota Legislature passed legislation in 1976 to ban mining on state lands located in the Wilderness.

In 1978, Congress took additional action that provided what was, at the time, a greater level of protection for the Boundary Waters than any other federal Wilderness. The 1978 Boundary Waters Wilderness Act banned mining in the Boundary Waters and on 220,000 acres of Superior National Forest lands along three entry corridors (Echo, Fernberg, and Gunflint) and along the southern edge of the Trout Lake Unit. Finally, the 1978 Act charged the U.S. Forest Service with protecting the Boundary Waters, including for the following purposes: "(1) provide for the protection and management of the fish and wildlife of the wilderness so as to enhance public enjoyment and appreciation of the unique biotic resources of the region, (2) protect and enhance the natural values and environmental quality of the lakes, streams, shorelines and associated forest areas of the wilderness, (3) **maintain high water quality in such areas, (4) minimize to the maximum extent possible, the environmental impacts associated with mineral development affecting such areas** . . ." (Pub. L. No. 95-495).

In 2003, the Minnesota Legislature designated 18,000 acres of state land within the perimeter of the Boundary Waters as 'wilderness' within the statutory classification of the Minnesota Outdoor Recreation Act. This is Minnesota's only state wilderness.

On December 14, 2016, the U.S. Forest Service withheld its consent to two applications for mineral lease renewals (the only two federal mineral leases in the Superior National Forest), finding that sulfide-ore copper mining in the watershed of the Boundary Waters posed an unacceptable risk of harm to the Boundary

Waters and that the resulting damage could never be fixed or mitigated. A 2017 Memorandum Opinion by the Interior Solicitor in the Trump Administration bypassed this withholding of consent, but the U.S. Forest Service did not withdraw its decision denying consent. In January 2022, the Interior Deputy Secretary Tommy Beaudreau canceled the two mineral leases because they had been renewed unlawfully. (NEPA violations; BLM regulation violations; and the lack of the Forest Service consent required by federal law).

On October 20, 2021, the U.S. Departments of Interior and Agriculture announced that the U.S. Forest Service filed an application for a 20-year mineral withdrawal of more than 225,000 acres of Superior National Forest lands located in the watershed of the Boundary Waters. The purpose of the withdrawal, as stated in the application, superbly describes what is at stake: the preservation of the world's greatest canoe country. The application precisely describes why a 20-year mineral withdrawal is not only appropriate, but critically necessary. Portions of the application are attached as **Attachment 6**. The centerpiece of the mineral withdrawal process Is a science-driven environmental analysis of potential impacts of mining on important natural and cultural resources of the Rainy River watershed, including the Boundary Waters: water quality, fish and wildlife, Tribal trust and treaty rights, and the local recreation and amenity-based economy, among other things. The result of this analysis informed the Secretary of the Interior's decision as to whether to grant the withdrawal request. The Forest Service prepared, and the BLM reviewed, an Environmental Assessment of the proposed federal mineral withdrawal; its extensive scientific, economic, and cultural analysis concluded that a mineral withdrawal was the best way to protect the unique ecosystem of the Boundary Waters. The potential for irreversible mining-related impacts on the Boundary Waters, the Mining Protection Area and other Protected Areas, and 1854 Ceded Territory, to the extent located within the Rainy River Watershed, warranted a mineral withdrawal for the maximum allowable period of 20 years. In contrast, the Forest Service concluded that a "piecemeal, project-specific" review would be a poor alternative to provid[ing] a "broader, more comprehensive approach to protect the ecological integrity of this area . . ." finding that a case-by-case, or mine-by-mine review, is an inefficient and time-consuming approach. Secretary Haaland acted to thwart a dire threat—sulfide-ore copper mining in the headwaters of the Wilderness—that would, without a doubt, have resulted in irreversible environmental and socioeconomic damage to the Headwaters, the Boundary Waters, and the region.

The history of Boundary Waters protection by the State of Minnesota and the federal government reflects the extraordinarily high value that Minnesotans and other Americans place on the Boundary Waters. The great majority of the people have demanded and continue to demand that the canoe country wilderness of northern Minnesota remain intact and ecologically healthy. **From the first public comment period on the issue of sulfide-ore copper mining in the watershed of the Boundary Waters in 2016 until the public comment period on the Mineral Withdrawal in 2021–2, the federal government has received over 675,000 comments from the American people urging protection of the Wilderness from sulfide-ore copper mining. The 120-year history of state and federal protection shows that their governments have listened and acted.**

The Concurrent Resolution is Unconstitutional

The resolution filed with the U.S. House to veto the Withdrawal Order that protects 225,504 acres of federal lands in the headwaters of the Boundary Waters by banning mining for 20 years is not only bad policy, but it is also unconstitutional. The Federal Land Policy & Management Act (FLPMA) explicitly delegates to the Secretary of the Interior the authority to make large-tract withdrawals of 5,000 acres or more of public lands from mineral extraction for up to 20 years. 43 U.S.C. § 1714(c)(1). Among other requirements, the statutory provision provides that such withdrawals "shall terminate and become ineffective at the end of ninety days" if Congress adopts a concurrent resolution of disapproval. This provision is widely understood to be an **unconstitutional legislative veto** under the U.S. Supreme Court's 1983 *Chadha* case. That case held that similar language in an immigration statute was unconstitutional because it violated the requirement that any congressional invalidation of an agency's exercise of lawfully delegated authority may only be accomplished through bicameral legislation followed by presentment to the President. *I.N.S. v. Chadha*, 462 U.S. 919, 959 (1983). Section 1130 of the House of Representatives Manual lists FLPMA's large-tract withdrawal authority as among several dozen unconstitutional legislative veto provisions that Congress has not amended since the *Chadha* decision. In a case challenging Secretary Ken Salazar's 2012 withdrawal of approximately 1 million acres surrounding Grand

Canyon National Park, mining proponents including the National Mining Association claimed, among other things, that the Secretary lacked authority to make the large-tract withdrawal because the legislative veto provision was both unconstitutional (as all parties agreed) and not severable from the statute. In a 2017 decision, the Ninth Circuit resoundingly rejected this claim, finding that the provision is severable from the large-tract withdrawal authority and therefore **the invalid legislative veto provision does not affect the Secretary's withdrawal authority.** *National Mining Ass'n v. Zinke*, 877 F.3d 845, 861-66 (9th Cir. 2017). As the court noted, Congress has never attempted to override exercise of the Interior Secretary's large-tract withdrawal authority, which has been used some 90 times since FLPMA's passage in 1976. Congress of course retains authority to override a large-tract withdrawal through normal legislative procedures.

Conclusion

The Boundary Waters is a priceless asset of the people of Minnesota and the nation; its clean water, healthy forests and wetlands, great array of wildlife, and world-class sport fishery are infinitely more valuable than the relatively small amount of minerals that could be extracted in the Withdrawal Area. The Withdrawal Order is a comprehensive approach to protect and preserve the fragile and vital social and natural resources, ecological integrity, and wilderness values in the Rainy River Headwaters, the Boundary Waters, and downstream Superior National Forest lands, Canada's Quetico Park, and Minnesota's Voyageurs National Park.

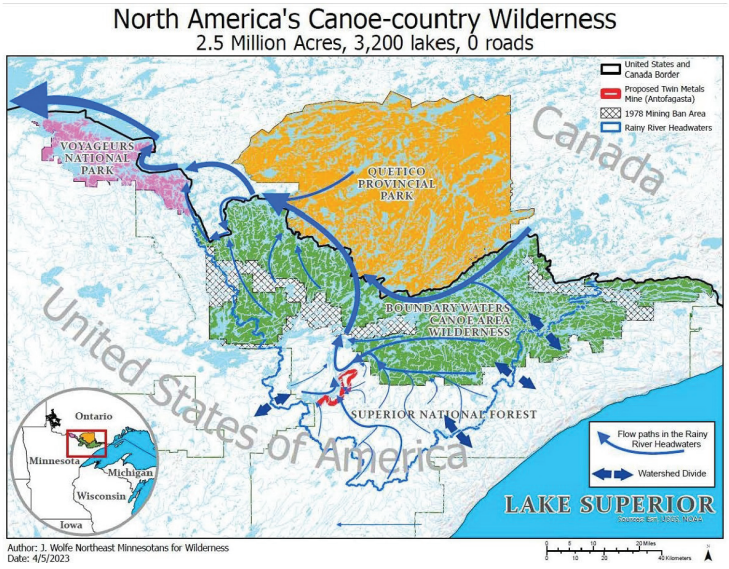
*****

Attachment 1

Aerial photo of the Boundary Waters and Quetico Park

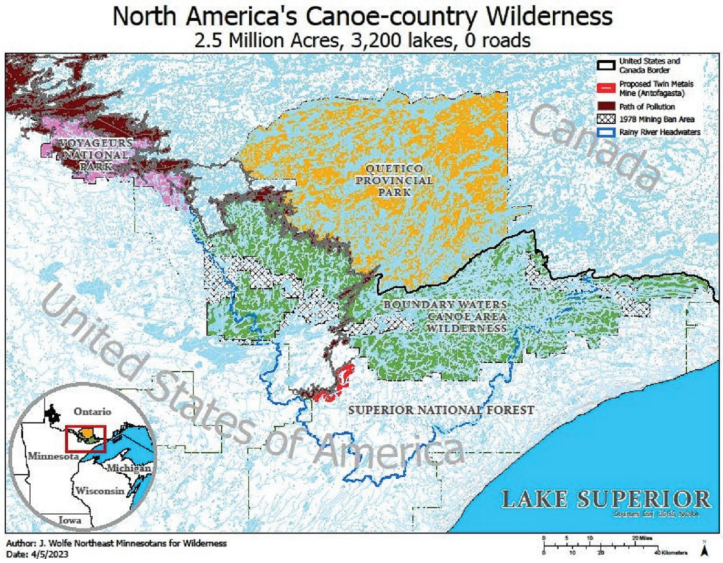
Attachment 2

Map of the water flowage from the headwaters into the Boundary Waters, Quetico Park, and Voyageurs National Park



Attachment 3

Map of the path pollution would flow from a Twin Metals mine; based on peer-reviewed and published hydrology study



Attachment 4

Minnesota Pollution Control Agency, Water quality and the Boundary Waters and the Rainy River Headwaters

Under Minn. Rule 7050.0335, Subp. 3.A., the waters of the Boundary Waters are "prohibited outstanding resource value waters." Minn. Rule 7050.0255, Subp. 14 states:

> *"Exceptional characteristics of outstanding resource value waters" means characteristics for which an outstanding resource value water is designated, including wilderness, scientific, educational, ecological, recreational, cultural, or aesthetic resource characteristics or other* ***special qualities that warrant stringent protection from degradation****."* (emphasis added)

Minn. Rule 7050.0265, Subp.7 is clear about the stringency of that protection: "The commissioner [of the Minnesota Pollution Control Agency (MPCA)] shall prohibit a proposed activity that results in a net increase in loading or other causes of degradation to prohibited outstanding resource value waters identified under part 7050.0335, subparts 3 and 4."

The antidegradation provision is designed to achieve and maintain the highest possible water quality: *"[W]ater quality necessary to preserve the exceptional characteristics of outstanding resource value waters shall be maintained and protected."* MN Rules 7050.0250.C.

During the past 20 years or so, Minnesota has expanded its policy regarding the protection of state lands and waters. In Minn. Stat. Sec. 103A.212 (2018), first adopted in 2010 (2010 Minn. Laws ch. 361, art. 4, Sec. 48), the Legislature set forth the watershed management policy of the state:

> *"The quality of life of every Minnesotan depends on water. Minnesota's rivers, lakes, streams, wetlands, and groundwater provide a foundation for drinking water and the state's recreational, municipal, commercial, industrial, agricultural, environmental, aesthetic, and economic well-being. The legislature finds that it is in the public interest to manage groundwater and surface water resources from the perspective of aquifers, watersheds, and river basins to achieve protection, preservation, enhancement, and restoration of the state's valuable groundwater and surface water resources."*

Thus, the policy of the State of Minnesota is to manage its waters from a watershed perspective and to preserve and protect those waters.

In 2017, the Minnesota Pollution Control Agency (MPCA) released its water quality assessment of the Headwaters, the Rainy River-Headwaters Watershed Monitoring Assessment Report (Report). The Report describes the excellent quality of the waterbodies within the watershed as having exceptional biological, chemical, and physicial characteristics worthy of additional protection:

> *"****The immaculate waters found within the watershed*** *not only produce some of the highest quality fisheries in the state but also offer visitors many scenic and natural views. The most visited Wilderness Area (Boundary Waters Canoe Area) in the United States is located within this watershed, with water as a major focal point.* ***Today over 99% of the Rainy River-Headwaters Watershed is undeveloped and utilized for timber production, hunting, fishing, hiking, and other recreational opportunities.*** *Large tracts of public land exist within this watershed, including county land, national and state forests, wildlife management areas, scientific and natural areas, state parks, and a national park. . . . Overall,* ***water quality conditions are good to excellent*** *and can be attributed to the forests and wetlands that dominate land cover within the Rainy River-Headwaters Watershed . . .* ***The majority of the waterbodies within the watershed had exceptional biological, chemical, and physical characteristics that are worthy of additional protection****."* (emphasis added) Report p.1.

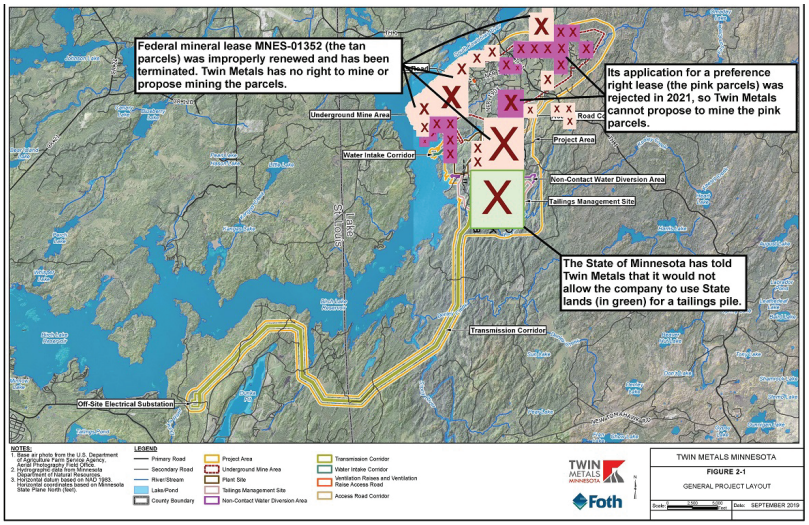
The Report said the 2021 Watershed Restoration and Protection Strategies report (WRAPS) for the Headwaters would focus on protection strategies to ensure that the watershed would remain pristine. As the draft WRAPS report, the MPCA press release about the report, and the water quality data make clear, the Headwaters deserves and requires complete protection.

> *"'The rivers and lakes in these watersheds are some of the cleanest waters in the state,' says Katrina Kessler, MPCA assistant commissioner for water policy and agriculture. 'That's why it's so important that we focus not only on restoring waters that don't meet water quality standards, but also protecting lakes and streams from becoming impaired in the first place. That's especially true for areas like the Boundary Waters that are enjoyed and treasured by so many residents and visitors.'"* MPCA reports: Protection rather than restoration is priority for two Boundary Waters watersheds (August 30, 2021 WRAPS press release)

The Headwaters includes 80.1% of the Boundary Waters. The MPCA notes that *"wilderness recreation and national park tourism are the prime economic drivers due to the scenic beauty, camping and fishing opportunities."* (https://www.pca.state.mn.us/water/watershed/rainy-river-headwaters) The extraordinary high water quality in the upstream portion of the Rainy River Headwaters was noted: *"[L]akes and streams in the watersheds* ***bordering*** *the Boundary Waters Canoe Area in northern Minnesota offer some of the most pristine water quality in the state."* (emphasis added) This extraordinary high water quality is attributed to the fact that *"[m]ore than 99 percent of the watershed is undeveloped and used both for timber production, and for hunting, fishing, hiking, and other recreation."* (https://www.pca.state.mn.us/water/watershed/rainy-river-headwaters and WRAPS press release) **This 99% naturally-vegetated landscape generates and delivers exceptionally clean water downstream through and to the non-wilderness portion of the Headwaters to the Boundary Waters and on to the border lakes shared with Ontario in Quetico and Voyageurs.** [emphasis added]

Attachment 5

Map of Twin Metals site plan



Attachment 6

Portions of the 2021 FLPMA Application for Superior National Forest Mineral Withdrawal

"The Federal lands associated with this withdrawal application are located within the Vermillion and Rainy Headwaters sub-watersheds of the Rainy River watershed in the Superior National Forest and are adjacent to the BWCAW and the MPA. The Rainy River watershed in Cook, Lake, and Saint Louis Counties in Minnesota supports outdoor recreation, wilderness, and biota critical to the socioeconomic conditions of the area. The BWCAW is a complex and interconnected ecosystem and offers recreational opportunities and other uses such that it is considered an irreplaceable national treasure. It provides opportunities for true solitude, outstanding primitive recreation in an unconfined and undeveloped natural setting, and a connection with untrammeled nature. Water, especially water quality, is a focal point for this wilderness. Approximately 1175 lakes varying in size from 10 acres to 10,000 acres and several hundred miles of streams comprise about 190,000 acres (20%) of the BWCAW surface area and provide for the opportunity for long distance travel by watercraft. This type of experience is rare within the continental United States and the BWCAW is the only large lake-land wilderness in the National Wilderness Preservation System. Potential impacts from mining could alter water quality and thus degrade key components of the wilderness ecosystem such as habitat for wildlife (lynx, moose, loons), fish (walleye, lake trout, and other game fish), and wild rice, and have negative impacts on the recreation economy and native culture and food systems.

Mining Affects People, Resources, and Wilderness Character

There is interest in the development of hardrock minerals, involving the removal or mining of sulfide-bearing rock, within this portion of the Rainy River watershed. Any development of these mineral resources could ultimately result in the creation of permanently stored waste materials and other conditions upstream of the BWCAW and the MPA with the potential to generate and release fugitive dust, tailings, and effluent with elevated levels of acidity, metals, and other potential contaminants. These impacts, and any potential failure of required mitigation measures, containment facilities, or remediation efforts at mine sites and their related facilities located upstream of the BWCAW and the MPA could lead to irreversible degradation of this key water-based wilderness resource and jeopardize the purposes for the designation of the BWCAW and the MPA specified by Sec. 2 of the BWCAW Act (Pub. L. 95-495, 92 Stat. 1649). These concerns are exacerbated by the fact that perpetual maintenance of waste storage facilities, along with the perpetual treatment of water discharge emanating from the waste storage facilities, will likely be required to mitigate and/or address these adverse effects, yet it is not certain that such maintenance and treatment can be assured in perpetuity. Additionally, increased traffic, noise, light, dust, and other emissions resulting from mining operations could change the character and experience of the wilderness, and would affect recreation experiences and other National Forest uses outside the wilderness, and the amenities-based economy that exists in the area. The Forest Service has reviewed the current circumstances and resulting threats to social, economic, and natural resources and now, as a matter of policy, seeks to pursue a holistic approach to ensure resource protection of this delicate ecosystem. This application is submitted to advance a comprehensive approach to protection of the fragile and vital social and natural resources, ecological integrity, and wilderness values that are threatened by potential future sulfide mining.

Salient examples of the potential impact of mining on key BWCAW resource components involve wild rice and fisheries, and the traditional uses and values drawn from them by Indigenous peoples. The requested withdrawal area is within the 1854 Ceded Territory for the Chippewa Bands, where their continued exercise of usufructuary rights to hunt, fish, and gather are protected by the 1854 Treaty of LaPointe. Treaty protected resources that are important to the subsistence-based lifestyle of the Bands include fish, wild rice, and other aquatic wildlife, which would be particularly vulnerable to any contamination caused by sulfide ore mining in the watershed. The ability to continue to have access to these food sources contributes to food security for the Bands. Wild rice, also known as "Manoomin" in Tribal language, is not only Minnesota's State Grain (MN Stat. Sec. 1.148) but also a key component of the spiritual and physical well-being of the Bands. According to a 2008 Minnesota Department of Natural Resources study (https://files.dnr.state.mn.us/fish_wildlife/wildrice/natural-wild-rice-in-minnesota.pdf):

Nowhere has natural wild rice been more important, nor had a richer history, than in Minnesota. No other native Minnesota plant approaches the level of cultural, ecological, and economic values embodied by this species. Natural wild rice has been hand harvested as a source of food in the Great Lakes region for thousands of years. The Ojibwe people have a special cultural and spiritual tie to natural wild rice. Known to their people as Manoomin, it is revered as a special gift from the Creator. In addition, many immigrants to Minnesota adopted hand harvesting of natural wild rice as an annual ritual.

The potential sulfide ore mining in this area has the potential to elevate sulfate levels in downstream waters (Miller 2002, USEPA 2014) and change the balance of the wilderness ecosystem and its associated subsistence lifestyle forever. If sulfate loading increases, evidence suggests that it would diminish the yield and ability to harvest wild rice and possibly present risks to food security. If sulfate enters wild rice waterbodies, it penetrates the sediment where the plant's roots grow. In these anaerobic conditions, bacteria transform (or "reduce") the sulfate into sulfide. Higher concentrations of sulfide can be toxic to roots and inhibit plant growth (Myrbo et. al. 2017a, Ng et. al. 2017, Pastor et. al. 2017, Pollman et. al. 2017). The scientific literature indicates elevated sulfate causes long-term declines in fish abundance, species number, and genetic diversity, and may facilitate the establishment of invasive species (Jennings et. al. 2008, Daniel et al 2014). As a result, the potential downstream effects from mining include sulfide impacts to wild rice production, an important economic and tribal commodity (Johnson et al. 2019).

Sulfates also result in the production of methylmercury, the toxic form of mercury that bio-accumulates in fish (Coleman et al. 2015, Myrbo et. al. 2017b). Lakes and streams in the area are already listed as impaired waters of the state for methylmercury in fish (MPCA 2007). Minnesota's State Bird, the Common Loon, an iconic symbol of the wilderness revered for its unusual wailing call, (https://www.youtube.com/watch?v=WDxtAoUQkSk&t=30s.; (https://www.projectremote.com/blog/loons-in-the-bounary-waters/) is often spotted by visitors of the BWCAW. The Common Loon is particularly sensitive to methylmercury (Evers et al 2008), a risk potentially exacerbated by mining. The flora and fauna of the BWCAW, as exemplified by the Common Loon and wild rice, are demonstrative of a distinct and irreplaceable wilderness resource. Moreover, the history of both Tribes and others in the region who practice a subsistence lifestyle is interwoven with the BWCAW and its water-based resources.

Climate change increases the risk of bioaccumulation of toxic mercury in the aquatic food chain (Ghandi et al. 2014). The Fourth National Climate Assessment (USGCRP, 2018) reveals that the average temperature in the contiguous United States has increased by 1.2°F (0.7°C) relative to the beginning of the last century. Temperature is expected to rise over the next few decades, regardless of emissions, by an estimated average annual temperature of 2.5°F (1.4°C). The upper Midwest has experienced the greatest rate of change in rising temperatures across the nation and significant increases in major storm events. Temperature has risen 2.0°F since the beginning of the last century. Since 2000, the number of very heavy rains (6 inches or more in a day) have been 2–3 times more frequent than in the 20th century (Runkle et. al, 2017). Climate change related to rising temperatures is increasing the overall availability and accumulation of forms of mercury in northern Minnesota wetlands (Pierce et al. 2019) which are connected to downstream aquatic food chains (Monson, B.A.).

Breaches or leakage of sulfate rich mine waters can have dramatic impacts on the production of the form of the toxic metal mercury which accumulates in the aquatic food chain, especially in fish. Also, the increased likelihood of larger storms, due to climate change, increases runoff and the potential for breaches of contaminated water to impact water supplies (Saniewska et al. 2014, Thomson and Rose 2011).

Minnesota Department of Health (MDH) fish consumption advisories for pregnant women, women who could become pregnant, and children under age 15 suggest safe consumption be limited to only one serving per month for many preferred species (lake trout, walleye) and one serving per week for whitefish, herring, and other species (For some lakes in the application area, the MNDNR advises not to eat the fish. For example, White Iron Lake in St. Louis County, MNDNR advises not to eat walleye larger than 23 inches. https://www.health.state.mn.us/communities/environment/fish/docs/eating/specpoplakes.pdf; MDH 2021). A 2011 MDH study indicated that 10 percent of Minnesota newborns in the Lake Superior Basin have toxic levels of mercury in their blood, likely from pregnant mothers eating fish (McCann

2011). Mercury in water and food has been shown to have detrimental effects on neural, nervous, and reproductive systems in humans with young children and developing fetuses particularly at risk (Kim et al. 2016, Henriques et al. 2019). Since subsistence users rely on these fish resources for food, increased mercury concentrations likely pose disproportional health risks to this population, raising an environmental justice issue.

Consequently, mining poses risks to perpetuating the health and traditional cultural values of the Chippewa Tribe due to impacts on wild rice, fish and other subsistence livelihood resources that connect the Chippewa to the land, their values, cultural heritage, and to one another. Hunting and gathering are cultural and spiritual activities that are crucial to the identity of the Chippewa (Great Lakes Indian Fish and Wildlife Commission (GLIFWC). 2016. Metallic Mineral Mining: The Process & the Price. https://www.flifwc.org/publications/pdf/2016Process.pdf; GLIFWC 2016).

As a final example, it is well documented that hardrock mining like that which is proposed adjacent to the BWCAW poses risks to public health from other changes to air and water. Six out of ten of the World Health Organization's identified chemicals of major public health concern are known to be released from hardrock mining. Arsenic, asbestos, cadmium, lead, particulate air pollution, and mercury could pose health risks such as cancer to workers and communities downstream and downwind of mining operations. A loss of a feeling of mental well-being due to the increased economic and emotional burden on families and individuals could arise from compromised health conditions due to toxic pollution of the region's air and water (Onello et. al. 2016).

Thus, the purpose underlying this withdrawal request is to effectuate a policy choice, based on current information concerning resources, uses, and threats, to pursue a holistic approach to protection of National Forest System resources located in the Rainy River Watershed, including the BWCAW, and the MPA, as well as the 1854 Ceded Territory, from the known and potential adverse environmental impacts arising from exploration and development of Federally-owned minerals conducted pursuant to the mineral leasing laws. *(emphasis added) Some of these concerns were identified in the Chief of the Forest Service's letter declining to consent to two hardrock mineral leases (MNES-01352 and MNES-01353) in December 2016, and prompted the filing of an application for a withdrawal of 234,328 acres of National Forest System (NFS) land on the Superior National Forest in January 2017. Others, such as Tribal and subsistence uses, and the effects of climate change on precipitation regimes were not, however. For the reasons set forth herein, the Regional Forester now believes that this new withdrawal application is a prudent, comprehensive course of action given the potential impacts to the social, cultural, economic, and natural resources described in part above, in light of pending plans for mine operations and pending applications for other hardrock mineral development activities within the withdrawal area."*

. . ."All these considerations, encompassing social, economic, cultural, and natural resource effects and legal implications, support the conclusion that a withdrawal order is a prudent and more comprehensive and efficient means to establish protection of National Forest resources from adverse mining impacts. Mining adjacent to BWCAW and MPA risks irreparable harm to irreplaceable wilderness and ecosystem integrity, values, and resources. Although the primary footprint of the proposed mines would be outside the BWCAW, there are critical linkages between aquatic and terrestrial ecosystems that are highly dependent on chemistry of water flowing through them. Large scale mining activity at the top of the watershed can cause many effects in the primary and secondary footprint related to water flow and chemistry (including aerial deposition) that will affect everything lower in the watershed. Given the high level of linkages between aquatic and terrestrial components of the ecosystem in the BWCAW, these effects will also extend into terrestrial vegetation and could cause an ecological cascade of effects to vegetation, wildlife, and rare species of plants and animals within the BWCAW wilderness. The expected extremes in precipitation and temperature due to warming climate are likely to exacerbate mining impacts, and reduce the resilience of forests and watersheds to disturbance caused by mining. (Frelich LE. Terrestrial Ecosystem Impacts of Sulfide Mining: Scope of Issues for the Boundary Waters Canoe Area Wilderness, Minnesota. USA. Forests. 2019; 10(9):747. https://doi.org/10.3390/f10090747)."

QUESTIONS SUBMITTED FOR THE RECORD TO MS. BECKY ROM, NATIONAL CHAIR, CAMPAIGN TO SAVE THE BOUNDARY WATERS

Questions Submitted by Representative Grijalva

Question 1. During the hearing, you mentioned several reports with relevant evidence addressing Members' questions. Could you please send the Committee any materials that clarify or expand on answers provided during oral questioning?

Answer. See articles that follow on the next page.

Ecological Economics 174 (2020) 106663

Contents lists available at ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Analysis of proposed 20-year mineral leasing withdrawal in Superior National Forest☆

James H. Stock[a,b,*], Jacob T. Bradt[b,1]

[a] Department of Economics, Harvard University, United States of America
[b] Harvard Kennedy School, Harvard University, United States of America

ARTICLE INFO

Keywords:
Economic impact analysis
Resource extraction
Recreation economy
Mining economy

ABSTRACT

The Rainy River Watershed on the Superior National Forest is home to the Boundary Waters Canoe Area Wilderness (BWCAW). It also contains deposits of copper, nickel, and trace metals, and copper-nickel mining has been proposed adjacent to and upstream of the BWCAW. In 2017, the US Department of Agriculture proposed withdrawing land in the Rainy River Watershed within the Superior National Forest from mineral leasing, a position it reversed in 2018. These developments highlight the potential tradeoff between economic benefits from mining and concerns about its negative economic consequences for the local recreational and amenity-based economy. Previous studies of mining in the Superior National Forest focus on static effects on a single industry (e.g., mining) at some unspecified point over a medium-run horizon. We draw on these studies and the economics literature to provide a unified analysis of the effect of the proposed mining development on income and employment over time. Our results suggest that the proposed mining would lead to a boom-bust cycle that is typical of resource extraction economies, exacerbated by the likely negative effect on the recreation industry.

1. Introduction

The Boundary Waters Canoe Area Wilderness (BWCAW), located within the Superior National Forest in northeastern Minnesota along the Canadian border, consists of more than one million acres of connected lakes and rivers. The BWCAW is one of the most visited wilderness areas in the United States, with 150,000 visitors in 2015 (US Forest Service, 2016). Those visitors support a varied outdoor recreation industry in gateway communities, primarily Ely, Minnesota (Hjerpe, 2018). The lakes and rivers outside the BWCAW also attract recreational visits and both seasonal and permanent residents who locate there for the outdoor and lakes amenities.

The region also has rich mineral deposits. The Mesabi Iron Range, the largest iron mining district in North America, extends for nearly 100 miles to the southwest of the BWCAW, with its most northeasterly portion within ten miles of the wilderness boundary (Minnesota

☆ An earlier draft of this study was submitted on August 6, 2018, in letter form, as a comment on the U.S. Forest Service's proposed withdrawal of Superior National Forest land within the Rainy River Watershed from mineral leasing. This revision reflects several updates to the 2018 letter. The most significant of these is that the 2018 letter considered only direct and indirect employment and income. In response to comments received on the original letter, the current revision now includes estimates of induced (spillover) employment and income. This revision also incorporates several other changes. For internal consistency, multipliers are now taken solely from University of Minnesota-Duluth, (2012) for mining and from Hjerpe (2018) for recreation. Additionally, wage rates are all for the Arrowhead county region whereas, in the 2018 letter, some wage rates were statewide. The discussion of related academic literature has been expanded, and procedural recommendations to the US Forest Service made in the 2018 letter have been removed from this version. Taken together, the revisions affect numerical values in the 2018 letter but do not change the conclusions. We thank Steve Polasky, Cathy Kling, John Hinderaker, Tom Landwehr, and two referees for their comments.

* Corresponding author at: Department of Economics, Harvard University, United States of America
E-mail address: james_stock@harvard.edu (J.H. Stock).

[1] Stock is Professor of Economics, Department of Economics, Harvard University. Bradt is a PhD student at the Harvard Kennedy School. Neither author received compensation for this analysis, nor has any financial interest in this matter, nor has engaged in paid consulting or paid expert testimony in this matter, nor has any other financial conflict of interest in this matter.

https://doi.org/10.1016/j.ecolecon.2020.106663
Received 25 June 2019; Received in revised form 21 February 2020; Accepted 25 March 2020
Available online 06 May 2020
0921-8009/ © 2020 Elsevier B.V. All rights reserved.

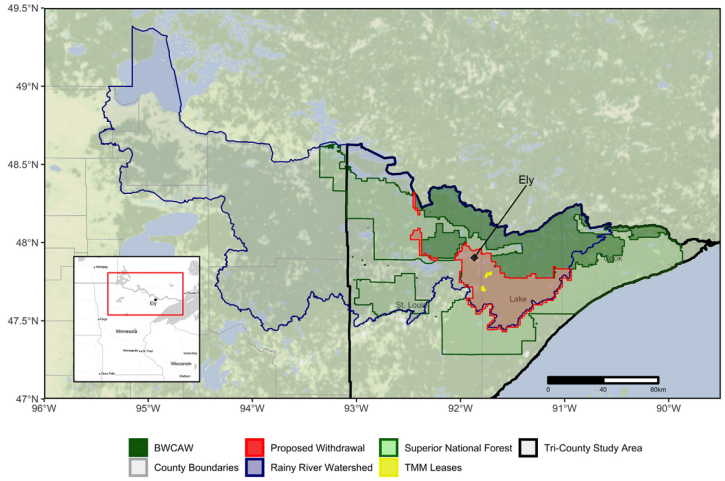


Fig. 1. Map of key hydrological and administrative features of the study area. The area of the proposed withdrawal of mineral rights within the Superior National Forest drains north into the BWCAW and encompasses the TMM mineral leases.
Sources: U.S. Forest Service, 2017, Minnesota Geospatial Information Office, 2020.

Department of Natural Resources, 2017). Although its high-grade iron ore (hematite) has been mined out, taconite mining continues, and taconite mining operations employed 3440 workers in 2016 (Minnesota Department of Natural Resources, 2017). In addition, there is commercial interest in developing copper-nickel mines in deposits both in and out of the Superior National Forest.

In particular, a copper-nickel mine, the proposed Twin Metals Mine (TMM), would be located in a site bordering and immediately upstream of the BWCAW (see Fig. 1).[2] The legal and jurisdictional setting is complex. The proposed site, along with much of the copper-nickel deposit, is on federal land for which mineral leasing rights are administered by the Bureau of Land Management (BLM), though the project also includes several state leases administered by the Minnesota Department of Natural Resources (DNR). The land is within the Superior National Forest, the surface of which is administered by the U.S. Department of Agriculture (USDA), and the USDA must consent to discretionary mineral leasing to ensure compatibility with the resource management objectives of the National Forest System. The USDA also administers the BWCAW, where federal law prohibits mining. Federal mining rights for the TMM project were originally granted in 1966 for a 20-year period with up to three 10-year renewals. The first two of these renewals were granted by the federal government. However, in December 2016 the USDA withheld its consent to renewal, citing concerns about negative impacts on the BWCAW, so the BLM denied the third renewal request.[3] In January 2017 under the Obama Administration, the U.S. Forest Service further proposed to withdraw from mineral leasing approximately 234,000 acres of federal lands within the Rainy River Watershed, which flows north into the BWCAW and which contains the TMM project, and it also initiated the preparation of an environmental impact statement (EIS) to assess the proposed withdrawal.[4]

In September 2018, the Trump Administration cancelled the withdrawal application and EIS,[5] and in May 2019 the BLM reversed its 2016 denial and renewed the TMM leases. TMM submitted its mine application to regulatory agencies in December 2019. The mine now awaits federal and state permitting, even as the federal lease renewal is currently being litigated.[6] Despite its cancellation, the proposed withdrawal remains a key part of the debate over mining near the BWCAW, and legislation that would permanently enact the Obama

[2] The Twin Metals Mine is a copper-nickel mine proposed by Twin Metals Minnesota, a subsidiary of Antofagasta PLC, one of the top ten copper producers by volume in the world. The project is located approximately nine miles southeast of the city of Ely, MN and proposes to mine sulfide-ore from the Maturi deposit of the Duluth Complex geologic formation. The Duluth Complex is one of the world's largest polymetallic deposits and in addition to copper and nickel includes cobalt and platinum group metals. Twin Metals Minnesota anticipates processing 20,000 tons of ore per day from the proposed sub-surface mining operation at the Twin Metals Mine (TMM, 2019a).

[3] Thomas Tidwell, Chief, BLM, Memorandum "Lease Renewal Application Rejected," December 15, 2016 at https://www.blm.gov/download/file/fid/7652.

[4] 82 FR 4282.

[5] https://www.usda.gov/media/press-releases/2018/09/06/usda-removes-roadblock-mineral-exploration-rainy-river-watershed.

[6] The TMM project is subject to multiple regulatory requirements. The project is subject to an environmental review process under the National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA). In December 2019, TMM submitted its Mining Plan of Operations to state and federal agencies for review, thereby initiating the formal NEPA/MEPA Environmental Impact Statement process (TMM, 2019c) (see https://www.dnr.state.mn.us/input/environmentalreview/twinmetals/index.html). Following completion of the EIS, the TMM project must receive permits by various federal, state, and local regulatory agencies to commence construction and operation. These permitting requirements regulate various aspects of the project construction and operation, including hazardous waste management, the disposal of wastewater, and maintenance of air quality standards (TMM, 2019b).

Administration's withdrawal has been introduced in the House of Representatives.[7]

The proposed TMM mine raises a classic conflict between recreational use and conservation on the one hand and mining development on the other, a conflict made more stark by the unique attributes and wilderness status of the BWCAW. Proponents of the mine point to the jobs and income it will create (University of Minnesota-Duluth, 2012; Orr et al., 2018). Opponents point to the risks to the watershed because of potential acid mine drainage and toxin release (Myers, 2016; Pearson et al., 2019), noise and light pollution that would disrupt the wilderness experience and negatively impact the local recreational industry (US Forest Service, 2016), and potential reductions in amenity-based in-migration (Sungur et al., 2014).[8]

The environmental risks associated with sulfide-ore copper mining within the watershed of the BWCAW are potentially economically consequential. Mining and beneficiation processes for underground copper ore generate large volumes of tailings. In a watershed hydrology model of possible mining locations in northeastern Minnesota, Myers (2016) finds that even relatively short-term leaks of tailing materials on the surface at mining locations in the region could cause substantial loads of sulfate, a major product of acid mine drainage, in the rivers and downstream resources of the BWCAW. The economics literature provides some insights concerning the economic costs associated with these adverse environmental impacts. In a study of acid mine drainage-impaired lakes in rural Ohio, Mishra et al. (2012) find a negative relationship between sulfate levels in impaired lakes and recreational use. The literature (reviewed below) documenting the transition of amenity-rich communities from reliance on extractive industries to tourism-based growth suggests a link between the two: were sulfide-ore copper mining to proceed at the TMM site, a contraction in tourism and recreation-based economic activity could plausibly occur, depending on the extent of mining disamenities that diminish the wilderness experience as well as on the severity of spills, breaches, and/or drainage.

While there have been reports issued on both sides of the issue,[9] those reports tend to look at snapshots in time, use different assumptions, and do not provide an integrated comparison of the economic costs and benefits of the proposed withdrawal.

Our study aims to fill this gap by providing an accounting of the impacts over time of the potential development of copper-nickel mining adjacent to the BWCAW on regional employment and income. We focus on the proposed TMM project because it is the sole copper-nickel mine currently proposed for the Rainy River watershed. We consider a 20-year horizon, which is the horizon of the Obama Administration's proposed mineral rights withdrawal. Because the focus is on the TMM project, the economic analysis focuses on the greater Ely region including usage of the Boundary Waters Canoe Area Wilderness (BWCAW) and nearby non-BWCAW lakes and forests. The study area is shown in Fig. 1. Our analysis draws on relevant regional and industry data, modeling in previous economic studies of the withdrawal, and the related economics literature. Our employment concept is employment in industries directly affected by the project (so-called direct employment), plus employment in the directly affected industry's supply chain (indirect employment), plus employment created by spending the earnings from direct and indirect employment (induced employment). Our income concept is total earnings from those direct, indirect, and induced jobs, taking into account differences in wages across sectors.

One of the challenges in this undertaking is the uncertainty around each of the many assumptions needed for this calculation. Although historical data inform distributions for some of our parameters, for others there is no evident way to calibrate a distribution, and moreover some of the parameters could covary and no data are available to quantify those covariances. As a result, a textbook treatment of uncertainty, for example Bayesian or Monte Carlo methods, is not practical in this situation. We therefore use a multiple scenario approach, which (as we explain) results in 72 different scenarios which in turn generate 72 different time paths for income and employment over the 20 years.

We find that, in all our scenarios, mining would produce an initial but temporary net growth of employment and income. Over time, however, the economic benefits of mining tend to be outweighed by the negative impact of mining on the recreational industry and on in-migration, leading to a boom-bust cycle. The preponderance of our scenarios indicates negative net present values of income resulting from the mining project. The primary drivers of the longer-run decline in incomes are increasing productivity in mining (estimated using historical data), reduced amenity-based in-migration, and reduced recreational demand. This boom-bust finding is consistent with recent papers on boom-bust cycles in extractive resource development.

The scope of this study – incomes and employment – is intentionally narrow, and we have omitted multiple factors which are likely important. These omitted factors include: effects on real estate values in the region; proprietors' income and profits; the value of the BWCAW and Superior National Forest as a regional attractor of talent in the Duluth area and elsewhere; and the employment and income driven by the BWCAW and Superior National Forest elsewhere in the state. We also do not consider non-market benefits such as non-market ecosystem services and wilderness existence values.

Although our focus is on the proposed TMM project, our impression is that the challenges confronting our study arise more generally in other natural resource extraction cases. These challenges include competing advocacy studies based on input-output models (or no models) that focus on a specific, unspecified date in the future and which potentially make mutually inconsistent assumptions; a lack of dynamic analysis that incorporates (for example) productivity growth and economic trends; a relative paucity of local data; and considerable uncertainty about key parameters. We hope that the methods used here for reconciling studies and estimating a range of dynamic impacts might be useful in other applications.

We first develop our scenarios and present the net present value calculations. We then discuss factors omitted from this analysis and discuss our results in the context of the relevant academic literature.

2. Computing costs and benefits over a 20-year horizon

We compute annual employment and income for the 20 years of the proposed withdrawal under two cases: the base case of the status quo in which there is no mining, which corresponds to a withdrawal of mineral rights, and the alternative in which the TMM mine is developed. In addition, we compute the net present values of the differences in income between the two cases.

We consider direct, indirect, and induced employment and income effects of the TMM case, relative to the base case. Direct employment is in the industries under study (mining and recreation). Indirect employment is in industries that serve the industry or project under study, for example in the case of mining, the change in employment in industries that provide mining services such as equipment repair. Induced

[7] Boundary Waters Wilderness Protection and Pollution Prevention Act, H.R. 5598, 116th Cong. (2020), https://www.congress.gov/116/bills/hr5598/BILLS-116hr5598ih.pdf.

[8] The conflict over the proposed TMM project is but the latest phase in a history of tension between mining and environmental concerns in Northern Minnesota, which has generated scholarly as well as public interest. Baeten et al. (2016) document the waste footprint of iron ore and taconite mining in the Mesabi Iron Range. Sutherland (2015) catalogs the challenges of economic transition from mining to tourism faced on the Cuyuna Iron Range, just south of the Mesabi, where production peaked in the 1950s. Bergstrom (2019) examines media coverage of copper-nickel mining in northern Minnesota. Liesch and Keweenaw, (2016) and Thistle and Langston (2016).

[9] University of Minnesota-Duluth (2012), Hjerpe and Phillips (2013), Sungur et al. (2014), Barber et al. (2014), Minnesota DNR (2015), Phillips and Alkire (2017), Helmberger (2017), Hjerpe (2018), Ward (2018), and Orr et al. (2018).

employment is the employment resulting from the spending of direct and indirect income on local goods and services. The direct and indirect income effects of the TMM counterfactual in a given year are the net effect on incomes from direct and indirect employment in mining and recreation of the TMM project, relative to the withdrawal case, plus the net direct effect on income from those attracted to the region by amenity values. This latter term captures the income spent in the region by those who choose to live in the region because of its amenity effects, and whose decision to live in the region might be affected by the withdrawal/no withdrawal decision.[10]

Induced income and employment are "spillover" effects of direct and indirect earnings which operate through a Keynesian multiplier channel.[11] Because mining jobs are better-paying than recreation jobs, a job in mining will result in more induced employment and income than a job in recreation. Whether induced employment and income effects actually materialize depends on the availability of unemployed or underemployed resources locally. If there is economic slack, then the direct and indirect earnings can create new local jobs. If, however, the economy is already at full employment, then what is calculated as induced employment either substitutes for other employment as workers change jobs or creates local jobs by expanding the work force as out-of-region workers move into the area. Recent empirical evidence in Auerbach et al. (2019) suggests that on average over periods of recession and expansion, there are nonzero induced local income and employment multipliers. The induced multipliers we use, which are taken from the IMPLAN studies of the Arrowhead economy, fall in the range estimated by Auerbach et al. (2019).[12]

The construction of our scenarios entails developing benchmark assumptions for employment and income under the case of the withdrawal, then considering alternative assumptions under the TMM counterfactual. To capture uncertainty, we vary key parameters to generate a total of 72 scenarios.

For our employment calculations, we make the following assumptions. For the case of the withdrawal, absent extant third-party growth forecasts of recreational employment in the greater Ely area, we rely on two sources of growth in employment related to recreation. In the Arrowhead region (St. Louis, Lake, and Cook counties), employment in the tourism and hospitality industries from 2012 to 2016 grew by 1.4% per year (Minnesota Department of Employment and Economic Development, 2017). USDA (2016) provides projections of increased recreational usage by category for 2008–2030; for the category "Backcountry/challenge" the annualized growth rate of user-days is 1.2%. We use this latter, lower value as the baseline in the withdrawal scenario because it is more directly relevant to BWCAW usage rather than outdoor recreation generally. Although Arrowhead region employment in recreational industries is available, we are unaware of data on the recreational employment base potentially specifically affected by the TMM project. Full Arrowhead region recreational employment (tourism and hospitality) in 2016 was 13,616, however that includes activity not likely to be directly impacted by the mining, such as hotels and restaurants serving University of Minnesota-Duluth and Duluth hospitals. Using the IMPLAN model and a survey of actual user expenditures, Hjerpe (2018) estimates that BWCAW visits from in-season out-of-region overnight visitors alone supports 879 direct jobs. Canoe camping in the BWCAW is just one way that recreational users take advantage of the outdoors in the region, so jobs potentially affected include more than just those supported by BWCAW out-of-region users. We therefore approximate the narrow direct employment definition from Hjerpe (2018) as accounting for one-fourth of potentially affected jobs. The full Superior National Forest area extends well to the east of Ely (see Fig. 1). For this reason, the assumption of 3516 (= 879 × 4) affected direct jobs could be an underestimate. We therefore consider an alternative case in which the number of affected direct jobs in tourism and recreational is 50% greater, 5274, which is still less than two-fifths the number of recreational and tourism jobs in the tri-county area.

Under the TMM counterfactual, in our high-mining scenario, we assume that TMM direct employment starts at 650 jobs, a figure taken from TMM materials (Twin Metals Minnesota, 2019a; Barber et al., 2014). We consider this estimate to reflect the high end of direct mining employment. The UMD-Duluth (2012) study projected 427 direct employment jobs in non-ferrous mining. In addition, in May 2018 TMM announced that it would scale back the planned mining from 50,000 tons per day to 20,000 tons per day, the figure in its December 2019 proposed Mining Plan of Operations. A proportional employment reduction of the TMM 650 jobs at 50,000 tons/day yields 260 direct employment jobs. We therefore consider two additional mining scenarios, intermediate, at 427 direct jobs, and low, at 260 direct jobs.

As shown in Fig. 2, non-ferrous mining generally, and copper mining specifically in the US, has exhibited substantial gains in productivity. Using the data in Fig. 2, we consider three mining productivity growth scenarios.[13] In all, this generates nine paths for annual

[10] We compute indirect employment from direct employment using indirect/direct proportionality factors from the IMPLAN model results reported for non-ferrous mining by UMD-Duluth (2012, Table 25) (Arrowhead region plus Douglas County, Wisconsin) and for recreation/hospitality by Hjerpe (2018, Table 5) (northeast Minnesota). Direct and indirect labor incomes are computed from direct and indirect employment using wage rates for 2016 for the Arrowhead region as discussed below.

[11] Of the four studies related to the withdrawal that use the IMPLAN model (UMD (2012), Minnesota DNR (2015), Hjerpe (2018), and Orr et al. (2018)), only Hjerpe (2018) and Orr et al. (2018) report labor income. The labor income multipliers (induced/(direct + indirect)) computed from results in Hjerpe (2018) and Orr et al. (2018) are respectively 0.214 and 0.347. With constant marginal propensities to consume out of labor income, the induced income multiplier should be the same for income earned regardless of its source (e.g., mining or recreation). One difference between the two studies that could account for these different multipliers is that Orr et al. (2018) consider state-wide effects whereas Hjerpe (2018) restricts effects to the northeast Minnesota region. Because the focus of our analysis is regional, not state-wide, we use the multiplier 0.214. This induced income multiplier is in line with the (induced/(direct + indirect)) value added multiplier of 0.18 in University of Minnesota-Duluth (2012), which is for the Arrowhead region plus Douglas County, Wisconsin. We compute induced employment from induced labor income using Arrowhead tri-county average wages for 2016. If the larger, state-wide induced multiplier of 0.347 is used, the numerical results change but the qualitative results, both for incomes and employment, do not.

[12] Auerbach et al. (2019) use US Department of Defense spending at the local region level and find that, for each $1 of US DOD spending in a locality, GDP in that state goes up by $1.50, so that the GDP multiplier ((indirect + induced)/direct) is 0.50. Their data covers 1997–2016 so includes both the strong labor markets of the late 1990s and mid-2000s and the long period of slack during and recovering from the financial crisis recession. Their estimate of an induced GDP multiplier of 0.50 is consistent with IMPLAN output multipliers. Hjerpe's (2018, Table 5) IMPLAN output multiplier ((indirect + induced)/direct) is 0.59 regionally (not state-wide) for recreation income. UMD's (2012, Table 25) regional GDP IMPLAN multiplier ((indirect + induced)/direct) is 0.43 for non-ferrous mining. The PolyMet FEIS (2015, Table 5.2.10-2) output multiplier is ((indirect + induced)/direct) is 0.55. Orr et al.'s (2018, Table 1) state-wide GDP IMPLAN multiplier ((indirect + induced)/direct) is 0.48.

[13] Fig. 2 shows an overall positive trend in output per employee in the Arizona copper industry from 1970 to 2016, across all hard rock metal mining from 1987 to 2017, and in underground coal mining separately in the three major U.S. coal producing regions from 2001 to 2016. The declines in copper mining output per employee in the mid- to late-2000's are associated with temporary changes in global commodity prices, and the decline in Appalachian underground coal productivity reflects the contraction in the industry and depletion of the higher productivity mines. The average growth rate of output per employee in the Arizona copper industry, 1970–2016, is 2.1% per year. We incorporate uncertainty using low and high productivity growth scenarios of 1.4%, and 2.7%, which are the end points of a 95% confidence interval for productivity growth estimated from the Arizona data. We assume a constant

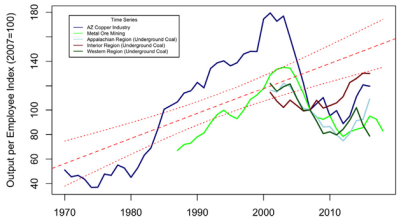


Fig. 2. Output per employee in copper, metal ore, and underground coal mining (index, 2007 = 100).
Sources: Energy Information Administration, 2016, Arizona Department of Mines and Mineral Resources, 1970, U.S. Geological Survey, 2015, Bureau of Economic Analysis, 1970-2017, Bureau of Labor Statistics, 1987-2016.

mining employment (three initial levels, three productivity growth rates).

Under the TMM counterfactual, we consider two paths for recreational employment, a low-impact path and a high-impact path. Because we are not aware of a directly comparable project (large-scale copper-sulfide-ore mining proximate to a water-based wilderness area) for which there are historical data, we consider a scenario in which recreational employment contracts at the rate of 1.2% per year and another in which it contracts at the rate of 2.4% per year. The first of these rates reverses the growth projected under the USDA baseline (USDA, 2016). The second of these rates is a reversal of twice the growth projected under the USDA baseline (USDA, 2016).[14] These counterfactuals are in line with previous studies of growth of other US amenity-based regional economies.[15]

We consider the high-impact scenario conservative in the sense that the impact on tourism over the long run of a major spill or acid mine drainage event are plausibly substantially more consequential.

For the income scenarios, the incomes associated with direct mining and recreational employment are computed using average local wage rates in those industries (Bureau of Labor Statistics, 2018; Minnesota Department of Employment and Economic Development, 2017). Employment in indirect and induced jobs are assumed to earn the average wage for the tri-county region in 2016 (Bureau of Labor Statistics, 2018; Minnesota Department of Employment and Economic Development, 2017).

The remaining component of income is the direct effect from those who move away from the region because of the mining and the related direct effect of those deterred from moving to, or retiring in, the region because of the mining (the "in-migration direct income"). To estimate this component, we used as a baseline the 2016 Census Bureau American Community Survey (U.S. Census Bureau, 2016) total income of the five-township Ely region (Ely, Eagles Nest, Fall Lake, Morse, and Stony River). We projected withdrawal baseline income growth as the sum of per-capita income growth and population growth. Our per-capita income growth projection is the historical per-capita income growth from 1970 to 2016 for the Arrowhead counties (Headwaters Economics, Economic Profile System, 2018). There is a large literature that documents increased population growth in amenities-rich areas (see Rickman and Rickman (2011) and Holmes et al. (2016) for surveys). We adopt the population growth rate from Rickman and Rickman (2011) for counties with USDA amenity rank equal to the average Arrowhead amenities rank (McGranahan, 1999). For the TMM counterfactual, we considered two scenarios for in-migration direct income. Polling by Sungur et al. (2014) found that 23% of residents would consider moving from the region in the event that the TMM project were undertaken. This estimate strikes us as high and many of those who would consider moving might not actually move. We therefore consider two scenarios one in which population growth slows to zero and a second in which in-migration population for amenity values declines by 10% over the 20-year period, less than half of the estimate in (Sungur et al., 2014).[16]

3. Results

In all, these assumptions generated 72 employment and income paths under the various scenarios. The employment paths are plotted in Fig. 3, and the income paths are plotted in Fig. 4.

All the scenarios in Figs. 3 and 4 show a similar pattern. Initially, mining is economically beneficial because of the new mining jobs, the income they produce, and their spillovers to the local economy. Over time, however, the net effect of the mining jobs erodes because of the growth of productivity in mining, the stagnation or decline of amenity-based in-migration, and the decline in wilderness-based recreation as a result of impacts of mining on the recreation industry. The magnitude and timing of the effect on employment and incomes varies across scenarios.

We computed the net present value for each of the income paths, using a 3% real discount rate (Office of Management and Budget, 2003). A histogram of these net present values is presented in Fig. 5. In 89% of the cases, the net present value of the TMM counterfactual is negative, that is, the income benefits of mining are outweighed by the income costs on recreation and in-migration. The cases for which the net present value of the TMM project are positive are those in which mining employment starts at the highest level (650 jobs, despite the

(*footnote continued*)
annual extraction rate, so that employment falls by the rate of growth of productivity for the three productivity scenarios.

[14] Rasker and Hackman (1996) examine employment and income trends in northwestern Montana and find that from 1969 to 1992, employment in counties characterized by pristine wilderness grew by 93%, an annualized rate of 2.9%. In contrast, resource-extractive counties observed employment growth of 15% over the same period, an annualized rate of 0.6%, a difference of roughly 2.3 percentage points. The scenario in which recreational employment contracts at the rate of 1.2% represents a difference of roughly 2.4 percentage points with respect to the withdrawal scenario. Thus, our rate of a 1.2% contraction in hospitality employment is reasonable assuming a reversal of Rasker and Hackman's (1996) estimate and is perhaps conservative given the degree to which hospitality and tourism employment is amenity-dependent.

[15] Rasker and Hansen (2000) examine rural counties in Idaho, Montana, and Wyoming and find that ecological and natural amenity variables are correlated with population growth in these areas. Deller et al. (2001) find similar results, finding a positive relationship between population growth and publicly owned land resources related to tourism. Winkler et al. (2007), find that "New West" communities, areas typically characterized by amenity migration, see anywhere from 38% to 195% higher employment in the tourism industry when compared to "Old West" communities. According to Winkler et al. (2007), this transition from "Old" to "New West" economic models has occurred over a 30-year period, which would imply an annual growth rate of between 1.2% and 6.5%. Empirical evidence supports the assertion that amenity-driven growth has supplanted extractive industries as the foundation of many amenity-rich, rural western counties (Lorah and Southwick, 2003). Rasker et al. (2013) find a positive relationship between growth in employment and proximity to protected public lands using data on federal lands in non-metropolitan Western counties. Henderson and McDaniel (2005) study sector-level employment growth and USDA natural amenity indices in more than 2000 rural U.S. counties, and find a statistically significant, positive relationship between landscape amenities and service sector employment growth.

[16] In-migrants are treated as bringing income to the economy but are not a business so do not undertake direct hiring, so there is no direct or indirect employment from this channel. That income is spent in part in the community, so it does generate induced employment and income, which are computed in the same way as induced employment and income from mining and recreation.

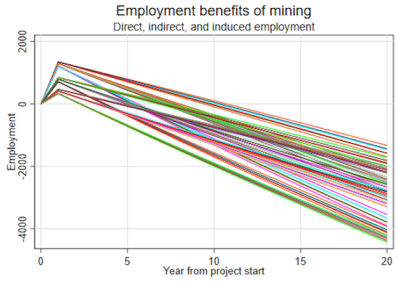


Fig. 3. Net annual employment effects (direct, indirect, and induced) of the TMM counterfactual over time on the Arrowhead economy. A positive employment value means that, under that scenario, the number of jobs in the TMM mining case exceeds the number of jobs in the no-mining baseline.
Notes: the horizontal axis denotes time, starting with the commencement of production at the TMM site.
Source: Authors' calculations.

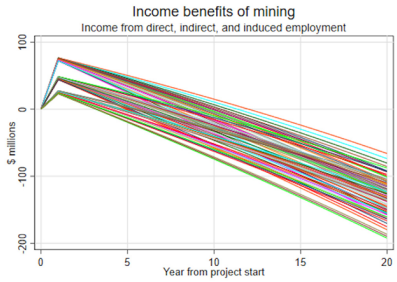


Fig. 4. Net annual income effects (direct, indirect, and induced) of withdrawal over time on the Arrowhead economy. A positive income value means that, under that scenario, the annual income in the TMM mining case exceeds the annual income in the no-mining baseline.
Notes: the horizontal axis denotes time, starting with the commencement of production at the TMM site.
Source: Authors' calculations.

2018 announcement and 2019 Mining Plan of Operations in which the project is scaled back) and impacts to tourism jobs and amenity-based in-migration are low.

4. Our estimates in the context of other studies

4.1. Other studies of rural economic growth and amenities

Multiple studies conclude that outdoor recreation and recreational amenities, especially wilderness amenities, have been the basis for strong and sustainable economic growth in rural communities with those attributes over the past two decades. This literature looks at a variety of measures including income, job growth, population growth in wilderness-abutting regions, willingness-to-pay, and property values. In early influential research, Deller et al. (2001) studied rural U.S. counties and concluded that "the empirical results provide strong evidence

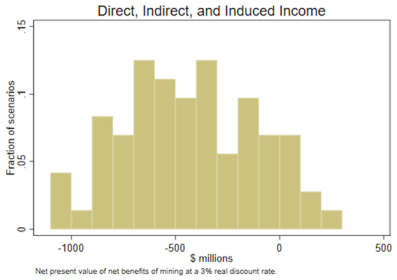


Fig. 5. Histogram of the net present value (NPV) of income in the 72 scenarios. Source: Authors' calculations.

that rural areas which can be characterized as endowed with high levels of key natural resource amenity endowments and overall quality of life experience higher overall levels of growth" (p. 363). Rickman and Rickman (2011) examine population trends and measures of outdoor and recreational amenity in nonmetropolitan counties across the U.S.; they establish a positive relationship between amenity values and population growth. Lorah and Southwick (2003) look at the role of protected federal lands, which hold an intrinsic natural amenity value, on rural population growth in western counties and find that counties with protected federal lands within 50 miles of their center grew approximately 12 times faster than nonmetropolitan western counties without protected federal lands within 50 miles of their center. Poudayal et al. (2008) analyze nationwide county-level data on the role of natural resource amenities in attracting retiree in-migration; they find that the percentage of a county under forest, the quantity of high-quality water resources, and the presence of federally-protected National Parks are all statistically significant drivers of retiree in-migration. Winkler et al. (2007) finds similar demographic trends. McGranahan et al. (2011) study the underlying mechanism whereby sustainable growth is linked to amenity values and find that this growth has an endogenous element through the channel of entrepreneurs being attracted to rural locations with high outdoor amenity value.

Holmes et al. (2016) provide a recent survey of the literature on valuation of proximity to wilderness areas. In addition to reviewing estimates of the local economic effects (or "onsite" values) examined here, they include a discussion of "offsite" values on which we have not relied. These "offsite" values include both "use" values (e.g., residential property values; see below) and three so-called "passive use" values: existence value, option value, and bequest value. They argue that these passive use values can be large, a point that is relevant to the withdrawal proposal because they attempt to estimate directly the value of pristine wilderness.

These studies validate the inclusion of in-migration effects that are supported by the withdrawal and are potentially at risk if the withdrawal does not occur. In addition, these studies support a broader interpretation of the value of the BWCAW and Superior National Forest as an attractor of non-tourism, non-retirement jobs to the area because of the proximate wilderness. This latter category of job is not included in our study, and by excluding such jobs our study is conservative and understates the economic benefits of the withdrawal.

4.2. Resource extraction and sustainable growth

The question of resource extraction and economic growth has long been of interest in the economics literature at the country level (e.g., oil export economies), regional level, and local level. Although we are not

aware of any recent hard-rock mining studies on sustainable local growth, the boom in nonconventional oil and gas development has stimulated recent research on extractive resource growth cycles.

Jacobsen and Parker, (2016) study county-level data for the American West and examine the consequences of oil and gas well drilling arising from the oil price increases of the 1970s and early 1980s. They find "that the boom created substantial short-term economic benefits, but also longer-term hardships that persisted in the form of joblessness and depressed local incomes.... In the longer run, after the full boom-and-bust cycle had concluded, we find that local per capita income was about 6% lower than it would have been if the boom had never occurred." (p. 1093).

Allcott and Keniston, (2018) study US county-level manufacturing data in connection with oil and gas booms and conclude that "while county-level population, employment, wages, and revenue productivity are all procyclical [i.e. all go up in the initial extractive stage], the booms are cancelled out by the busts. By the end of the 1990s, we see no significant remaining long-term effects of the boom and bust cycle of the 1970s and 1980s (p. 697)".

There is also some work on the economic impacts of nonconventional oil and gas extraction, however the scope for dynamic analysis is limited because that development is new and insufficient time has elapsed to observe a full cycle. One set of limited dynamic estimates is provided, however, by Feyrer et al. (2017). They use local geographic data to provide some estimates of the dynamic effect of nonconventional oil and gas extraction in the 2000s; they find that it has large employment effects, but that those employment effects are transitory at the local level. They only estimate dynamics over the first two years following the initial local extraction shock and find that wage income gains, including direct, indirect, and induced, dissipate by 1/3 within two years (the dissipation is faster if only direct and indirect wages are considered, see their Fig. 4). Because the technology for nonconventional oil and gas extraction has a shorter life cycle than hard rock mining or conventional oil and gas extraction, the findings of these studies are all qualitatively consistent with an extractive boom-bust cycle.

These studies are designed to estimate the effects of these booms on counties with average amenity values. Thus, these estimates capture the boom-bust effect on resource extraction and related jobs but do not include any special effects that resource extraction disamenities or environmental damage would have on employment and in-migration related to high-amenity regions like the area surrounding the BWCAW. Such effects would exacerbate the boom-bust nature because of the deterioration in environmental conditions and amenity values that would reduce non-mining amenity-related incomes.

4.3. Property values and mining disamenities

There is substantial evidence that mining disamenities reduce housing values. In their study of acid mine drainage (AMD) from coal mining in the Cheat River Watershed of West Virginia, Williamson et al. (2008) find that location near an AMD-impaired stream has an implicit marginal cost of $4783 on housing, or nearly 12.2% of a home's value. Kim and Harris (1996) examine the broader suite of possible mining disamenities and their effect on property values near a copper mine in Green Valley, AZ and find that parcels closest to the mining site lost 5.74% of their value with homes further away losing 0.66% of their value. In their study of sulfide-ore copper mining in the Arrowhead region, Phillips and Alkire (2017) use Kim and Harris' (1996) findings to estimate that the total loss in property value due to sulfide-ore copper mining would be approximately $508 million (2016 USD), or roughly 1.9% of the total property value of the three Arrowhead region counties. This is a large value which, if added to the NPVs in Fig. 5, would make all the NPVs negative.

Phillips and Alkire's (2017) estimate of a decline of 1.9% is in the range of those in related studies. Boxall et al. (2005) examine the impact of oil and gas facilities on rural residential property values in central Alberta, Canada using hedonic regression methods for property valuation.[17] They find that location within four km. of industry facilities leads to a four to 8% decrease in property value. Leggett and Bockstael (2000) use a hedonic property model to show that water quality has a significant effect on property values along the Chesapeake Bay, an amenity-rich, non-metropolitan setting with high recreational value. Poor et al. (2007) find a similar result in the Chesapeake Bay watershed examining non-point source pollutants, including suspended solids and nitrogen. In a study of the impact of lake water clarity on New Hampshire lakefront properties, Gibbs et al. (2002) find that water clarity—a measure of the degree of eutrophication—has a significant effect on prices paid for residential properties. More recent research linking local water quality to higher property values includes Keiser and Shapiro (2019) and Kuwayama et al. (2019).

In the case of the proposed withdrawal, these negative effects on housing values would be compounded by the downward pressure on housing values from reduced in-migration or, possibly, out-migration. Consistent with the boom-bust literature, one could see an initial rise in housing values as mine and associated industry workers buy or rent in the greater Ely area, however that increase would be temporary as mining employment, recreational employment, and in-migration housing demand subsequently decline. By omitting this effect, our analysis is conservative and likely understates the benefits of the proposed withdrawal.

5. Conclusion

We find that, over the 20-year time horizon of the proposed withdrawal, introducing copper-nickel mining in the Superior National Forest is likely to have a negative effect on the regional economy. Our calculations omit some factors, notably the negative effect of mining on real estate values, that would strengthen this conclusion. We reviewed the relevant literature and conclude that our findings are consistent with the literature, most notably the history of boom-bust economies associated with resource extraction that leave the local economy worse off.

In addition to adding to the debate over copper-nickel mining in the Superior National Forest, our study contributes to the broader literature on the tradeoffs between resource extraction and natural amenity-based economic growth. Our findings highlight the importance of considering the long-term effects of resource extraction in natural amenity rich areas. While estimates of the employment effects of the TMM project are positive in the short run, accounting for the well-documented boom-bust cycle that characterizes resource extraction results in negative estimates of the overall effect of allowing mining in the Superior National Forest. This analysis also demonstrates the importance of modeling dynamic responses to resource extraction in amenity-based income, for example through decreased in-migration and reduced demand for amenity-driven recreation.

Our study points to opportunities for future research. As noted previously, we omit several factors which are likely important to fully understand the impacts of allowing mining near the BWCAW, including both market values (such as housing) and non-market values (ecological services). Future work examining the effects of copper-nickel mining in this region should examine the long-run effects of mining on these additional values. More broadly, the prospective modeling approach of our study, which is shared by many other studies in this field, would ideally be complemented by empirical analysis of historical data. Additional work is needed on ex-post evaluation of the economic effects

[17] Hedonic regression is a method for estimating the value of a characteristic of a good when that characteristic is not sold separately but instead is part of a bundle of characteristics embodied in the good; see for example Haab and McConnell, 2002.

of resource extraction in comparable, ideally quasi-experimental, settings.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Allcott, H., Keniston, D., 2018. Dutch disease or agglomeration? The local economic effects of natural resource booms in modern America. Rev. Econ. Stud. 85, 695–731.
Arizona Department of Mines and Mineral Resources, 1970-1990. Average Number of Covered Employees in Primary Copper Industry. Primary Copper Industry of Arizona - Annual Reports. http://repository.azgs.az.gov/collection/AzMMR.
Auerbach, A., Gorodnichenko, Y., Murphy, D., 2019. Local fiscal multipliers and fiscal spillovers in the United States. In: NBER Working Paper 25457.
Baeten, Langston, J.N., Lafreniere, D., 2016. A geospatial approach to uncovering the hidden waste footprint of Lake Superior's Mesabi Iron Range. The Extractive Industries and Society 3 (4), 1031–1045.
Barber, John, Parker, Harry, Frost, David, Hartley, Janine, White, Trey, Martin, Chris, Sterrett, Robert, Poeck, Joanna, Eggleston, Ted, Gormely, Lynton, Allard, Simon, Annavarapu, Srikant, Radue, Tom, Malgesini, Matthew, Pierce, Matthew, 2014. Twin Metals Minnesota Project: Technical Report on Pre-feasibility Study. Prepared for Duluth Metals Corp. 6 October 2014.
Bergstrom, R.D., 2019. Community development in the face of resource extraction in northern Minnesota, USA. The Extractive Industries and Society 6 (3), 831–841.
Boxall, P.C., Chan, W.H., McMillan, M.L., 2005. The impact of oil and natural gas facilities on rural residential property values: a spatial hedonic analysis. Resour. Energy Econ. 27 (3), 248–269.
Bureau of Economic Analysis, 1970-2017. Regional Data. https://www.bea.gov/index.htm (retrieved 14 July 2018).
Bureau of Labor Statistics, 1987-2016. Labor and Multifactor Productivity Data by Industry: Four Digit Industry Data. U.S. Department of Labor. https://www.bls.gov/lpc/tables_by_sector_and_industry.htm (retrieved 14 July 2018).
Bureau of Labor Statistics, 2018. Occupational Employment Statistics: May 2017 State Occupational Employment and Wage Estimates. U.S. Department of Laborhttps://www.bls.gov/oes/current/oessrcst.htm (retrieved on 14 July 2018).
Deller, Steven C., Tsai, Tsung Hsiu (Sue), Marcouiller, David W., English, Donald B.L., 2001. The role of amenities and quality of life in rural economic growth. Am. J. Agric. Econ. 83 (2), 352–365.
Energy Information Administration, 2016. Coal Data Browser. U.S. Department of Energy. https://www.eia.gov/coal/data/browser/#/topic/36?agg=2,0,1&geo=nvg1qag9vvlpg&mntp=4&freq=A&start=2001&end=2016&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0 (retrieved 14 July 2018).
Feyrer, J., Mansur, E.T., Sacerdote, B., 2017. Geographic dispersion of economic shocks: evidence from the Fracking revolution. Am. Econ. Rev. 107 (1313-1224).
Gibbs, Julie P., Halstead, John M., Boyle, Kevin J., Huang, Ju-Chin, 2002. An hedonic analysis of the effects of lake water clarity on New Hampshire lakefront properties. Agricultural and Resource Economics Review 31 (1), 39–46.
Haab, T.C., McConnell, K.E., 2002. Valuing Environmental and Natural Resources: The Econometrics of Non-market Valuation. Edward Elgar Publishing, Inc, Northampton, MA.
Headwaters Economics, 2018. A Profile of Socioeconomic Measures: St. Louis County, MN; Cook County, MN; and Lake County, MN. Headwaters Economics and U.S. Census Bureauhttps://headwaterseconomics.org/tools/economic-profile-system/about', Accessed date: 19 July 2018.
Helmberger, Marshall, 2017. Ely's golden goose. In: The Timberjay, 3 August 2017. http://timberjay.com/stories/elys-golden-goose,13540.
Henderson, J.R., McDaniel, K., 2005. Natural amenities and rural employment growth: a sector analysis. Rev. Reg. Stud. 35 (1), 80–96.
Hjerpe, Evan, 2018. Outdoor recreation as a sustainable export industry: a case study of the boundary waters wilderness. Ecol. Econ. 146, 60–68.
Hjerpe, Evan, Phillips, Spencer, 2013. A Review of 'The Economic Impact of Ferrous and Non-ferrous Mining on the State of Minnesota and the Arrowhead Region'. Report prepared by Conservation Economics Institute and Key-Log Economics (30 December 2013).
Holmes, Thomas P., Bowker, J.M., Englin, J., Hjerpe, E., Loomis, John B., Phillips, Spencer, Richardson, Robert, 2016. A synthesis of the economic values of wilderness. J. For. 114 (3), 320–328.
Jacobsen, Grant D., Parker, Dominic P., 2016. The economic aftermath of resource booms: evidence from boomtowns in the American West. Econ. J. 126 (593), 1092–1128.
Keiser, D.A., Shapiro, J.S., 2019. Consequences of the clean water act and the demand for water quality. Q. J. Econ. 134 (1), 349–396.
Kim, H.S., Harris, D., 1996. Air quality and view degradations due to copper mining and milling: preliminary analysis and cost estimates for Green Valley, Arizona. Nonrenewable Resources 5 (2), 91–102.
Kuwayama, Y., Olmstead, S., Zheng, J., 2019. The Value of Water Quality: Estimating Amenity and Recreational Benefits. Manuscript. LBJ School, University of Texas – Austin.
Leggett, Christopher G., Bockstael, Nancy E., 2000. Evidence of the effects of water quality on residential land prices. J. Environ. Econ. Manag. 39 (2), 121–144.
Liesch, Matthew, Keweenaw, Creating, 2016. Parkmaking as response to post-mining economic decline. The Extractive Industries and Society 3 (2), 527–538.
Lorah, Paul, Southwick, Rob, 2003. Environmental protection, population change, and economic development in the rural western United States. Popul. Environ. 24 (3), 255–272.
McGranahan, David, 1999. Natural Amenities Drive Rural Population Change. AER-781. Economic Research Service, U.S. Department of Agriculture.
McGranahan, David A., Wojan, Timothy R., Labert, Dayton M., 2011. The rural growth trifecta: outdoor amenities, creative class and entrepreneurial context. J. Econ. Geogr. 11, 529–557.
Minnesota Department of Employment and Economic Development, 2017. Current Employment Statistics Data Tool. https://mn.gov/deed/data/data-tools/current-employment-statistics/ (retrieved on 14 July 2018).
Minnesota Department of Natural Resources, 2017. The Mesabi Iron Range (Map) at. https://files.dnr.state.mn.us/lands_minerals/mpes_projects/mnmin2017_mesabi.pdf.
Minnesota Department of Natural Resources, US Army Corps of Engineers, and US Forest Service, 2015. NorthMet Mining Project and Land Exchange: Final Environmental Impact Statement.
Minnesota Department of Natural Resources, U.S. Army Corps of Engineers, U.S. Forest Service, 2015. Final Environmental Impact Statement: Polymet Mining, Inc. - NorthMet Mining Project and Land Exchange. MDNR Division of Ecological and Water Resources, St. Paul, MN.
Minnesota Geospatial Information Office, 2020. Minnesota Geospatial Commons. https://gisdata.mn.gov/.
Mishra, Shruti K., Hitzhusen, Frederick J., Sohngen, Brent L., Guldmann, Jean-Michel, 2012. Costs of abandoned coal mine reclamation and associated recreation benefits in Ohio. J. Environ. Manag. 100, 52–58.
Myers, Tom, 2016. Acid mine drainage risks – a modeling approach to siting mine facilities in Northern Minnesota USA. J. Hydrol. 533, 277–290.
Office of Management and Budget, 2003. OMB Circular A-4: Regulatory Analysis. Executive Office of the Presidenthttps://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf.
Orr, Isaac M., Struhsacker, Debra W., Phelan, John, 2018. Unearthing Prosperity: How Environmentally Responsible Mining Will Boost Minnesota's Economy. Center of the American Experiment.
Pearson, Jennifer, Ipsen, John, Sutherland, Steven, Wegerson, Kristan, Onello, Emily, 2019. Risks and costs to human health of sulfide-ore mining near the boundary waters canoe area wilderness. Human and Ecological Risk Assessment: An International Journal. https://doi.org/10.1080/10807039.2019.1576026.
Phillips, Spencer, Alkire, Carolyn, 2017. Sulfide-ore copper mining and/or a sustainable boundary waters economy: the need to consider real tradeoffs. In: Key-Log Economics LLC. Report Prepared for Northeastern Minnesotans for Wilderness.
Poor, P. Joan, Psagno, Keri L., Paul, Robert W., 2007. Exploring the hedonic value of ambient water quality: a local watershed-based study. Ecol. Econ. 60 (4), 797–806.
Poudayal, Neelam C., Hodges, Donald G., Ken Cordell, H., 2008. The role of natural resource amenities in attracting retirees: implications for economic growth policy. Ecol. Econ. 68 (1–2), 240–248.
Rasker, Ray, Hackman, Arlin, 1996. Economic development and the conservation of large carnivores. Conserv. Biol. 10 (4), 991–1002.
Rasker, Ray, Hansen, Andrew, 2000. Natural amenities and population growth in the Greater Yellowstone Region. Hum. Ecol. Rev. 7 (2 (winter 2000)), 30–40.
Rasker, Ray, Gude, Patricia H., Delorey, Mark, 2013. The effect of protected federal lands on economic prosperity in the non-metropolitan west. Journal of Regional Analysis & Policy 43 (2), 110–122.
Rickman, Dan S., Rickman, Shane D., 2011. Population growth in high amenity non-metropolitan areas: What's the prognosis? J. Reg. Sci. 51, 863–879.
Sungur, Engin, Asche, Kelly, Fluegel, David, Ronnader, Reid, Bibeau, Jacob, 2014. The Four Townships Area Economic, Housing Development Survey. Center for Small Towns and Data Services Center, University of Minnesota at Morris.
Sutherland, F., 2015. Community-driven mining heritage in the Cuyuna Iron Mining District: past, present, and future projects. The Extractive Industries and Society 2 (3), 519–530.
Thistle, H., Langston, N., 2016. Entangled histories: iron ore mining in Canada and the United States. The Extractive Industries and Society 3 (2), 269–277.
Twin Metals Minnesota, 2019a. About Twin Metals Minnesota. http://www.twin-metals.com/wp-content/uploads/2019/12/TMM_FactSheet_December2019.pdf.
Twin Metals Minnesota, 2019b. Mine Plan of Operations: Twin Metals Minnesota Project – Environmental Review Support Document. Doc. no. TMM-ES-115-0001. http://www.twin-metals.com/wp-content/uploads/2019/12/TMM-Mine-Plan-of-Operations_2019-1218-R.pdf.
Twin Metals Minnesota, 2019c. Press Release: Twin Metals Minnesota Submits Mine Plan to State and Federal Agencies for Review. http://www.twin-metals.com/twin-metals-minnesota-submits-mine-plan-to-state-and-federal-agencies-for-review/.
U.S. Census Bureau, 2016. American Community Survey. U.S. Department of Commerce. https://www.census.gov/programs-surveys/acs/ (retrieved 18 July 2018).
U.S. Department of Agriculture, 2016. Federal Outdoor Recreation Trends: Effects on Economic Opportunities. U.S. Forest Service, Pacific Northwest Research Station General Technical Report (PNW-GTR-945).
U.S. Forest Service, 2017. Northern Minnesota Federal Withdrawal: Supporting Documents at https://www.fs.usda.gov/project/?project=50938. U.S. Department of Agriculture.
U.S. Forest Service, 2016. Letter From Thomas Tidwell, Chief, US Forest Service to Neil Kornze, Director, BLM, Dec. 14, 2016. at. https://www.blm.gov/download/file/fid/7645.

U.S. Geological Survey. 2015. Copper statistics through 2015, *in* Kelly, T.D., and Matos, G. R., comps., Historical Statistics for Mineral and Material Commodities in the United States (2016 Version): U.S. Geological Survey Data Series vol. 140. https://minerals.usgs.gov/minerals/pubs/historical-statistics/.

University of Minnesota-Duluth, 2012. The Economic Impact of Ferrous and Non-ferrous Mining on the State of Minnesota and the Arrowhead Region, Including Douglas County, Wisconsin. University of Minnesota, Duluth, Labovitz School of Business and Economics, Duluth, MN.

Ward, Fabrizio, 2018. Save the boundary waters survey: Minnesota registered voter telephone survey. In: Report for Save the Boundary Waters, (13 April 2018).

Williamson, J.M., Thurston, H.W., Heberling, M.T., 2008. Valuing acid mine drainage remediation in West Virginia: a hedonic modeling approach. Ann. Reg. Sci. 42 (4), 987–999.

Winkler, Richelle, Field, Donald R., Luloff, A.E., Krannich, Richard S., Williams, Tracy, 2007. Social landscapes of the Inter-Mountain West: a comparison of 'old west' and 'new west' communities. Rural. Sociol. 72 (3), 478–501.

Journal of Hydrology 533 (2016) 277–290

Contents lists available at ScienceDirect

Journal of Hydrology

journal homepage: www.elsevier.com/locate/jhydrol

Acid mine drainage risks – A modeling approach to siting mine facilities in Northern Minnesota USA

Tom Myers [1]

6320 Walnut Creek Road, Reno, NV 89523, United States

ARTICLE INFO

Article history:
Received 24 June 2015
Received in revised form 4 November 2015
Accepted 11 December 2015
Available online 18 December 2015
This manuscript was handled by Geoff Syme, Editor-in-Chief, with the assistance of Craig T. Simmons, Associate Editor

Keywords:
Acid mine drainage
Contaminant transport
Groundwater modeling
Watershed management

SUMMARY

Most watershed-scale planning for mine-caused contamination concerns remediation of past problems while future planning relies heavily on engineering controls. As an alternative, a watershed scale groundwater fate and transport model for the Rainy Headwaters, a northeastern Minnesota watershed, has been developed to examine the risks of leaks or spills to a pristine downstream watershed. The model shows that the risk depends on the location and whether the source of the leak is on the surface or from deeper underground facilities. Underground sources cause loads that last longer but arrive at rivers after a longer travel time and have lower concentrations due to dilution and attenuation. Surface contaminant sources could cause much more short-term damage to the resource. Because groundwater dominates baseflow, mine contaminant seepage would cause the most damage during low flow periods. Groundwater flow and transport modeling is a useful tool for decreasing the risk to downgradient sources by aiding in the placement of mine facilities. Although mines are located based on the minerals, advance planning and analysis could avoid siting mine facilities where failure or leaks would cause too much natural resource damage. Watershed scale transport modeling could help locate the facilities or decide in advance that the mine should not be constructed due to the risk to downstream resources.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

Acid mine drainage (AMD) is a problem associated with mines throughout the world (Jacobs and Testa, 2014). In the United States, promoting mining on public lands has been a priority since the 1800s (Leshy, 1987), with little consideration for the waste other than getting it away from the mine site being the practice prior to about 1970 (Church, 1996; Ferderer, 1996). Mines were developed with little concern regarding AMD (Crews, 1973; Williams, 1975).

That is no longer the situation. Mining-caused contamination is a global problem and few sites are isolated or sufficiently underused that potential contamination can be ignored. One example of global cooperation among the mining industry, conservation groups, and stakeholders to set a higher standard for mining, including the prevention of AMD and promotion of it remediation is the Initiative for Responsible Mining Assurance (IRMA) (http://www.responsiblemining.net/). The goal of IRMA is to promote responsibility by certifying the most responsible mines.

Watershed-scale planning is necessary to avoid the most serious problems. However, much watershed-scale research focuses on remediation (Church et al., 2007; Crews, 1973; Kimball et al., 2006; Nimick and von Guerard, 1998; Skousen et al., 1999), often with the perspective of optimizing treatment (Crews, 1973; Kimball et al., 1999). Conceptual and numerical modeling at various scales can aid in prioritizing sites for remediation (Myers, 2013; Runkel et al., 2013). Herr et al. (2003) developed a watershed-scale model of AMD entering a river to show the contaminant sources and potentially demonstrate the effectiveness of remediation of specific sites. Runkel and Kimball (2002) simulated flow and equilibrium chemistry along a stream heavily impacted by AMD to demonstrate the effects of remediation. Related modeling showed that simulation results are most affected by model parameters affecting a nearby stream reach or watershed (Gooseff et al., 2005). Myers (2013) suggested priorities for remediating phosphate mines based on a groundwater model of a large western watershed contaminated with selenium. Statistical models also can show the mining features or geology that best explain the variability in salinity discharging from a mined watershed (Evans et al., 2014). These studies however do not suggest a means of avoiding AMD or other contamination issues as part of the planning process.

Preventing future mines from becoming AMD problems is often considered an engineering issue at the mine site (Jacobs et al., 2014; Buxton et al., 1997; EPA, 1994), although failures occur often

[1] Hydrologic Consultant.
E-mail address: Tommyers1872@gmail.com

http://dx.doi.org/10.1016/j.jhydrol.2015.12.020
0022-1694/© 2015 Elsevier B.V. All rights reserved.

(Caldwell and Charlebois, 2010; Kuipers et al., 2006; Rico et al., 2008). The level of damage caused by these failures can depend on their location in the watershed. Missing from the literature and generally from mine planning is research showing methods designed to site mines and mine facilities to avoid large-scale AMD problems when leaks occur.

The objective of this study was to use watershed-scale groundwater flow and transport modeling to predict which mine sites in a sulfide rich watershed would be more likely to cause downstream AMD problems if engineering controls fail. It demonstrates how watershed-scale modeling prior to the actual development of mines can improve mine planning to facilitate future remediation when engineering failures occur, a topic currently not substantially addressed in the literature. The setting is the Birch Lake watershed, located within the larger Rainy Headwaters watershed in northern Minnesota, USA (Fig. 1). The area has no current mining and one historic mine. Mining companies hold leases on at least six different copper/nickel deposits (MNDNR, 2014) within the watershed. The Boundary Waters Canoe Area Wilderness (BWCAW), a high value and one of the most-visited wilderness areas in the United States (Heinselman, 1996), lies directly downstream of the potential mining (Fig. 1).

The model could help to optimize mining and waste disposal locations or to decide whether the risks of mining are too high as well as providing information on where more information is needed for decision making. The model could be an example for countries and companies around the world contemplating entering relatively pristine watersheds currently valued for resources that could be damaged by mine pollution.

2. Method of analysis

2.1. Study area

The study area is in the Birch Lake watershed south of the South Kawishiwi River in northeastern Minnesota, USA (Fig. 1). The middle two thirds of the study area overlies the Duluth Complex while the north end abuts Granite Range granite (Fig. 2, Table 1). The Duluth Complex hosts nickel–copper–platinum sulfide deposits in the basal portion of the South Kawishiwi intrusion as much as 1200 m below ground surface (Miller et al., 2002; Parker and Eggleston, 2014). The deposits are potentially significant acid-producers (EPA, 1994; Lapakko, 1988; Lapakko and Olson, 2015; Polymet Mining, 2013b; Polymet Mining, 2012; Severson et al., 2002). The sulfide content of the Spruce Road deposit is 2–5% by volume and 3–4% by weight (Parker and Eggleston, 2014), which may on the high end of the range for the Duluth Complex (Seal et al., 2015). The host mineralized zone has previously produced AMD (EPA, 1994; Lapakko, 1988; Lapakko and Olson, 2015).

Most mining leases lie south of the South Kawishiwi River in the Birch Lake and Stone Creek watersheds (Fig. 2). Proposed mines are expected to initially be underground (Cox et al., 2009; Parker and Eggleston, 2014), including some underground waste rock and tailings disposal (Twin Metals, 2014). Waste rock is rock and overburden removed to reach the ore and tailings are the processed ore from which the valuable mineral has been removed. Waste rock and tailings are considered contaminant sources for this paper because mine planning as to the placement of either material is not sufficiently advanced to distinguish among the properties of either type.

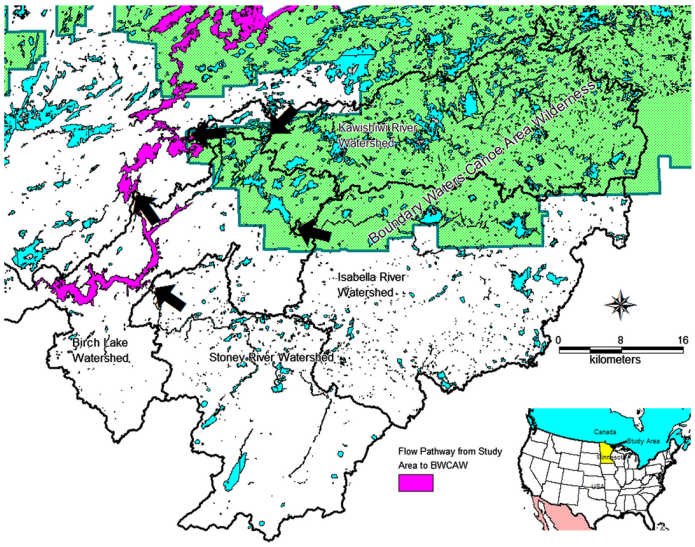


Fig. 1. Rainy Headwaters watershed and study area, showing subwatersheds, rivers, and lakes. Arrows are flow direction from watersheds. Watershed boundaries from Dnr100kwatersheds, www.mngeo.state.mn.us/chouse/metalong.html.

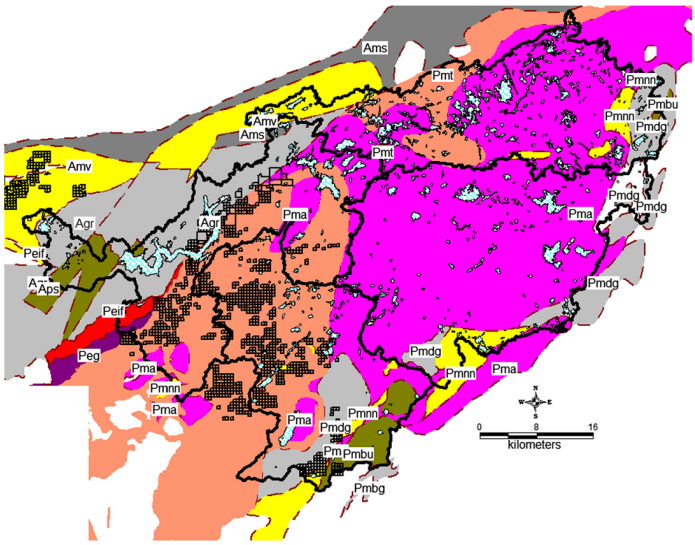


Fig. 2. Bedrock geology and watersheds of the study area. See Table 1 for a description of the formations. See Fig. 1 for the watershed names. The black rectangles are mining leases and approximate location of the mineral deposits.

Table 1
Geologic formations (Nicholson et al., 2007) along with model zone, layer and final calibrated horizontal and vertical conductivity (Kh and Kv, respectively) in meters/day. *n* is effective porosity, Sy is specific yield, and Ss is storage coefficient.

Formation/lithology		Zone	Kh	Kv	Sy	Ss	*n*	Layer
Duluth Complex, troctolite/gabbro	Pmt	2	0.307	0.01008	.07	.000001	.007	3
		12	0.342	0.137	.12	.00001	.012	2
		22	0.102	0.114	.12	.00001	.012	2
		32	0.00014	0.0182	.07	.000001	.007	3
		33	0.035	0.0145	.12	.00001	.012	2
Duluth Complex, anorthosite/gabbro	Pma	3	0.025	0.2	.07	.000001	.007	3
		13	2.9	0.4	.12	.00001	.012	2
		31	0.26	0.002	.12	.00001	.012	2
Basalt/rhyolite	Pmnn	4	0.05	0.025	.07	.000001	.012	3
		14	0.1	0.06	.12	.00001	.012	2
Giants range Granite	Agr	5	0.0015	0.0015	.02	.000001	.002	3
		15	0.214	0.2	.05	.00001	.005	2
		25	0.8	0.5	.05	.00001	.005	2
Gabbro/troctolite	Pmbu	6	0.27	0.01	.08	.000001	.008	3
		16	2	0.09	.14	.00001	.014	2
Biwabik iron formation	Peif	7	0.16	0.001	.3	.00001	.3	3
		17	0.36	0.0075	.4	.0001	.4	2
		27	0.3	0.001	.4	.001	.4	1
		37	26	0.02	.4	.001	.4	1
Shale/siltstone	Peg	8	0.1	0.01	.03	.000001	.003	3
		18	2	0.1	.05	.00001	.005	2
Surficial aquifer		38	7.4	0.16	.15	.01	.015	1
		39	1	0.05	.15	.01	.015	1
		40	5.2	0.1	.15	.01	.015	1

2.2. Conceptual flow model

Four HU10-scale (USGS et al., 2013) watersheds form the study area: Birch Lake, Stony River, Isabella River, and Kawishiwi River (Fig. 1). Surface water flows north and west from Birch Lake and the Kawishiwi River watershed through the Kawishiwi River and several lakes to the BWCAW. Rivers from the Stony River and Isabella River watersheds flow into the Birch Lake watershed (Figs. 1 and 3). Lakes and wetlands connected by low-gradient rivers cover much of the study area which generally has relief less than 10 m from a divide to nearby lakes and rivers.

A surficial aquifer consisting of glacial till or sand and gravel generally less than 3–6 m thick covers the area (Mast and Turk, 1999). Hydraulic conductivity (K) of the sand/gravel surficial aquifer ranges from 0.000003 to 1070 m/d, or over nine orders of magnitude, for the surficial aquifer (Siegel and Ericson, 1981; Stark, 1977; Winter, 1973). Well yields in the Kawishiwi watershed are less than 54 m^3/d (Siegel and Ericson, 1981) reflecting the very thin to nonexistent surficial aquifers.

The Duluth Complex (Fig. 2) is a low-permeability intrusive formation with a very low K (Table 1) except possibly near some of the infrequent faulting, on which there is little available hydrogeologic data (Miller et al., 2002; Thorleifson, 2008), and in the upper 30 m which is relatively fractured with well yields from 27 to 82 m^3/d. The plutonic rocks have primary porosity up to 3%, but the effective permeability is very low because the pores are isolated (Stark, 1977). The specific capacity of wells in the Duluth Complex ranges from 0.36 to 1.97 m^3/d/m. In bedrock, fractures control permeability and secondary porosity, and also flow paths. Porosity in the fractured Biwabik formation is as high as 50%.

Total flow, or total runoff, from the watershed above the gage for US Geological Survey gaging stations in the area (Fig. 3), was divided into direct runoff and baseflow using methods of Lim et al. (2005, 2010) (Table 2). Yield is total stream flow per area and ranges from 21.6 to 31.2 cm per year (cm/y). Baseflow varies from 14.4 to 24.2 cm/y, although for watersheds with more than 160 square km, it varies from 17.0 to 20.8 cm/y. Assuming recharge is baseflow distributed over drainage area (Cherkauer, 2004; Scanlon et al., 2002), the average recharge is 19.2 cm/y, or 0.00052 m/d for the study area.

Based on gages 7, 5, 2, and 1 (Table 2), subwatersheds Birch Lake, Stony River, Isabella River, and Kawishiwi River (Fig. 3) yield recharge equal to 0.00052, 0.00047, 0.00049, and 0.00054 m/d, respectively. However, the low rates for the small watersheds, Dunka River near Babbitt and Filson Creek gages, 0.00044 and 0.00046 m/d, respectively, illustrate the heterogeneity of the recharge distribution.

Many factors control the recharge distribution, including wetlands, soil types, and soil landforms, including whether the soil is well drained, whether the soils contain substantial peat (Siegel et al., 1995), and whether the bedrock is shallow. Using several statewide GIS soils databases (Land Management Information Center, 1996), maps of wetland coverage, hydrologic soil classification (NRCS, 2007), soil type, surface and subsurface permeability were developed to illustrate the variability (Fig. 4a through e) (Cummins and Grigal, 1980).

A commonly-used method for estimating regional-scale recharge in Minnesota for areas less than 5000 km^2 based on precipitation, growing degree days, specific yield (based on Rawls et al. (1982)) and baseflow recession indices (Delin et al., 2007; Lorenz and Delin, 2007) yielded a recharge estimate for the

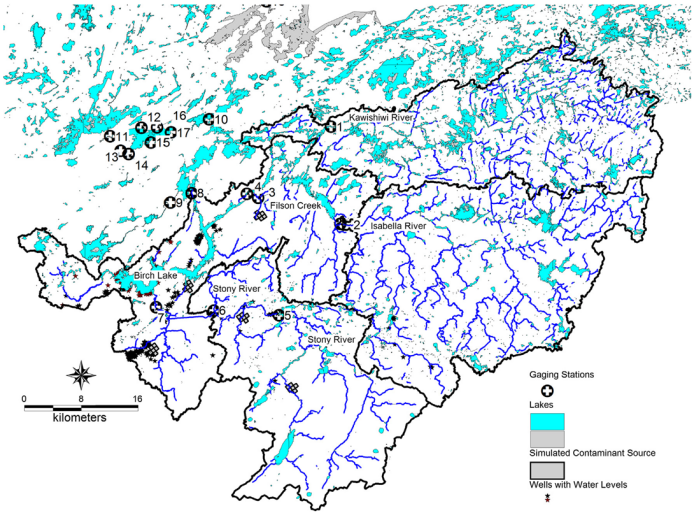


Fig. 3. Location of wells with water levels, gage stations, perennial streams, and lakes in the study area. See Table 2 for a list of gage stations. *Source:* http://mcc.mn.gov/gis.html#state_minerals_head.

Table 2
U.S. Geological Survey gaging stations and station parameters. See Fig. 3 for the location. BFI is baseflow index, the proportion of total flow that is baseflow.

No	USGS site no	USGS site name	Area (km^2)	Avg flow (m^3/d)	Avg runoff (m^3/d)	Base flow (m^3/d)	BFI	Rech (m/d)
1	05124480	KAWISHIWI RIVER NEAR ELY, MN	657.9	461,164	108,226	352,938	0.77	0.00054
2	05124500	ISABELLA RIVER NEAR ISABELLA, MN	883.2	686,970	256,400	430,571	0.63	0.00049
3	05124990	FILSON CREEK IN SESW SEC. 24 NEAR WINTON, MN	25.0	18,642	7211	11,431	0.61	0.00046
4	05125000	SOUTH KAWISHIWI RIVER NEAR ELY, MN	0.05	991,271	248,969	742,301	0.75	0.00000
5	05125500	STONY RIVER NEAR ISABELLA, MN	466.2	307,811	89,744	218,067	0.71	0.00047
6	05126000	DUNKA RIVER NEAR BABBITT, MN	138.3	94,826	34,147	60,679	0.64	0.00044
7	05126210	SOUTH KAWISHIWI R ABV WHITE IRON LAKE NR ELY, MN	2167.8	1,573,205	443,911	1,129,295	0.72	0.00052
8	05126500	BEAR ISLAND RIVER NEAR ELY, MN	177.4	105,117	28,451	76,666	0.73	0.00043
9	05127000	KAWISHIWI RIVER NEAR WINTON, MN	3185.7	2,419,154	746,217	1,672,937	0.69	0.00053
10	05127205	BURNTSIDE RIVER NEAR ELY, MN	178.7	145,526	34,005	111,521	0.77	0.00062
11	05127207	BJORKMAN'S CREEK NEAR ELY, MN	3.5	2626	1239	1388	0.53	0.00039
12	05127210	ARMSTRONG CREEK NEAR ELY, MN	13.7	11,186	4516	6670	0.6	0.00049
13	05127215	LONGSTORFF CREEK NEAR ELY, MN	22.9	18,984	7403	11,581	0.61	0.00051
14	05127219	SHAGAWA RIVER Trib AT ELY, MN	1.8	259	155	103	0.4	0.00006
15	05127220	BURGO CREEK NEAR ELY, MN	7.9	7977	3477	4499	0.56	0.00057
16	05127230	SHAGAWA RIVER AT ELY, MN	256.4	219,331	49,307	170,025	0.78	0.00066
17	05127500	BASSWOOD RIVER NEAR WINTON, MN	4506.6	3,284,031	724,319	2,559,712	0.78	0.00057

Kawishiwi watershed of 20–30 cm/y. This estimate is similar to the total runoff yield and exceeds the recharge estimates made herein by approximately 20–30%. Surface storage in wetlands and small lakes and subsurface storage in the unsaturated zone and groundwater, which support long-term baseflow (Sophocleous, 2002), could explain the differences among estimates. Microscale topography embedded within larger flow systems connected by small surface drainages and interflow causes large variability in flowpath length (Winter, 1998). This may cause surface runoff hydrographs to have long receding legs which resemble groundwater discharge and are difficult to separate from the runoff hydrograph which may cause errors in estimates based on statistical analyses using baseflow recession (Delin et al., 2007; Lorenz and Delin, 2007).

Baseflow follows a seasonal pattern. Average monthly river flow at the Kawishiwi River near Ely gage peaks at more than 80 cm/y during May just two months after the low flow of less than 8 cm/y recorded in March. Much recharge would occur during this snowmelt freshet flood because water runs on the ground surface and river and stream levels are higher than the water levels in the streambanks. After reducing to less than 20 cm/y by September, the baseflow fluctuates between 10 and 20 cm/y until reaching its low in March.

2.3. Conceptual transport model

Waste rock and tailings developed from ore bodies in the study area would likely become sources of AMD-related contaminants because of accelerated oxidation of the ore's high sulfide contents (Bain et al., 2000; EPA, 1994; Jacobs et al., 2014; Johnson and Hallberg, 2005; Lapakko, 1988; Lefebvre et al., 2001; Nash and Fey, 2007; Polymet Mining, 2013b, 2012). Oxidation within a surface waste rock dump, the most common means of disposal (Lottermoser, 2010; Nash and Fey, 2007), is complex due to multiphase flow within the rock (Lefebvre et al., 2001). Pathways are either across the ground surface (Nordstrom, 2011) or through poorly-buffered groundwater (Bain et al., 2000; Jones et al., 2014; Mayes et al., 2007; Siegel, 1981; Siegel and Ericson, 1981) to streams. Often, the existence of groundwater seepage containing a contaminant load is found only through tracers or synoptic sampling that finds a load at a certain location not accounted for by surface samples (Kimball et al., 2002).

Waste may be backfilled underground to submerge the waste more quickly and decrease the discharge of contaminants (Johnson and Hallberg, 2005). This means of disposal can be a significant short-term source of contaminants (Kohfahl et al., 2004; Neal et al., 2005; Runkel et al., 2013) as the recovering groundwater submerges backfilled waste and leaches oxidation products into the groundwater.

Sulfate transport in the Rainy Headwaters is conservative because of a lack of buffering in the watershed and in general is conservative at typical concentrations (>100 mg/l) (Nordstrom, 2011, 2008). Most transport through bedrock in this watershed is through fractures that have limited surface area limiting contact time with any carbonate rock. Sulfate transport in groundwater flow to streams has responded conservatively in other similar situations (Neal et al., 2005; Nordstrom, 2008; Runkel et al., 2013). A good example is Straight Creek in the Red River Valley of New Mexico; groundwater flowed through an unconfined debris-fan aquifer without attenuation of metals and with sulfate being diluted by fresher groundwater inflows (Nordstrom, 2008), as modeled herein.

2.4. Numerical flow and transport model

A reconnaissance-level numerical flow and transport model using MODFLOW-2000 (Harbaugh et al., 2000) and MT3DMS (Zheng and Wang, 1999) was developed to simulate the conceptual models described above. Model flowpaths and contaminant travel times were estimated using the MODPATH code (Pollock, 1994). The dominant model cell size is a 500-m square which approximates the 16.2-hectare mining leases, expanding to 1000-m squares away from the leases in the upper Kawishiwi and Isabella River watersheds (Fig. 5). Three model layers represent the general stratigraphy, with layer 1 being the surficial till and sand/gravel layer and layers 2 and 3 being bedrock, with layer 2 bedrock being more fractured with higher K (Table 1). The top elevation was based on 30-m and 10-m digital elevation models (DEMs) (Fig. 5). Layer 1 was 15-m thick, based on the median and mean depth to bedrock being 14 and 17.4 m. Layer 2 thickness was set so that the total thickness of layers 1 and 2 equaled 140 m. The bottom of layer 3 was set at elevation −1000 m.

MODFLOW DRAIN boundaries, head-controlled flux boundaries that only allow water to leave the model domain, were specified for larger lakes and rivers which cover most of the area due to close surface–groundwater connections (Fig. 6). The lake boundary head was set one m below the top elevation of the model cells so that lakes would receive inflow only when the groundwater level is close to the ground surface. The river head was set five m below the average top elevation of each model cell to simulate discharge to rivers with embedded channels. General head boundaries (GHB), with head and distance to head based on lake water levels just across the boundary, allow groundwater to cross the northern

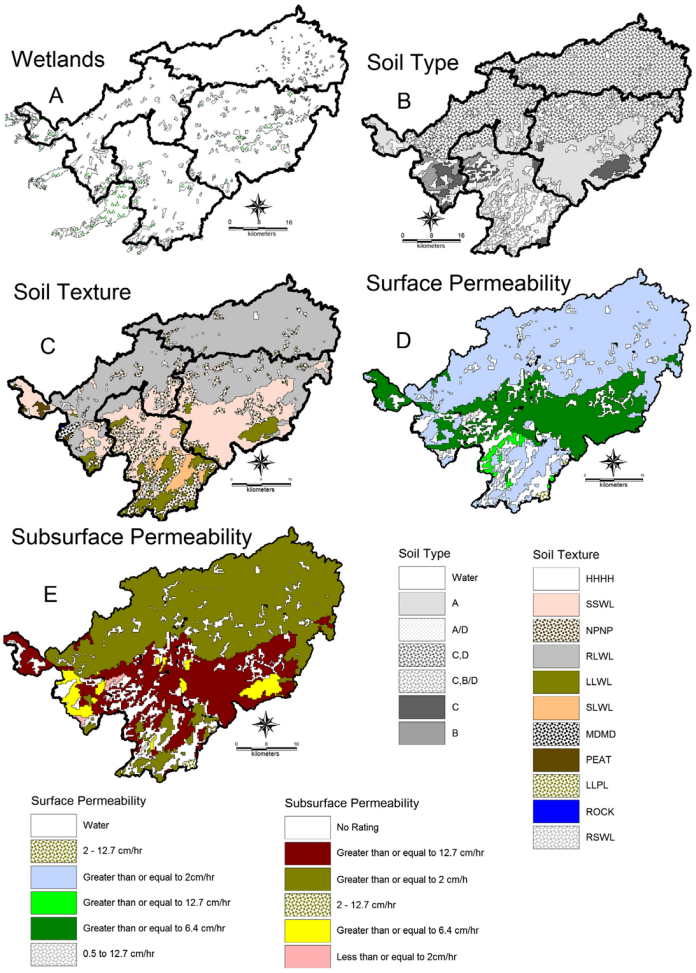


Fig. 4. Distribution of wetlands and soil types across the study area (Cummins and Grigal, 1980). Stream file Strm_baseln3, lakes and wetlands from Dnr100khydrography, from www.mngeo.state.mn.us/chouse/metalong.html. Soil type: 1234; Factor 1: Texture of soil below 5 feet, S is sandy, L is loamy, C is clayey, X is mixed sand and loam, Y is mixed silt and clay, R is bedrock; Factor 2: Texture of soil in top 5 feet, as for factor 1; Factor 3: Drainage, W means well-drained, P means poorly drained; Factor 4: Color, D is dark, L is light.

Kawishiwi watershed boundary (Fig. 6) at topographic low points. Recharge zones were specified based on subwatershed (Fig. 6), with rates set so that recharge equals the measured baseflow in the primary rivers.

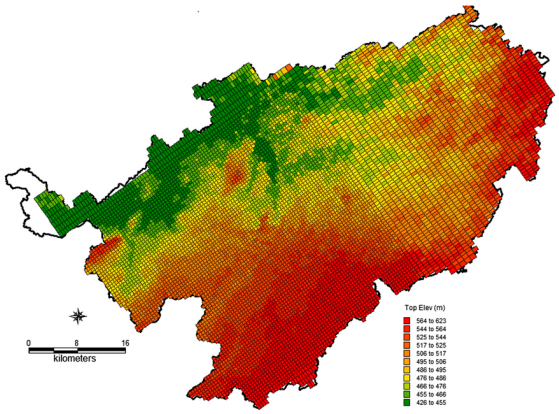


Fig. 5. Model grid and layer 1 top elevation by cell in meters.

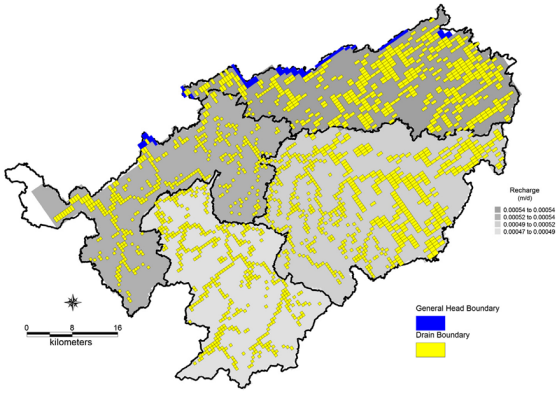


Fig. 6. Location of DRAIN and recharge boundaries in layer 1 and general head boundaries (GHBs) in layer 2. Final recharge rates equal 0.00054, 0.00049, 0.00047, and 0.00052 m/d for zones 2 through 5, respectively.

Transport modeling of sulfate was completed using MT3DMS (Zheng and Wang, 1999). In addition to advection controlled by the flow model and effective porosity (Table 1), the variation of which would simply proportionally increase or decrease contaminant arrival time, dispersion affects concentration by spreading the contaminants along and transverse to the flow path (Fetter, 1999). Dispersivity is a function of length of the flow path from source to sink (Fetter, 2002; Xu and Eckstein, 1995). The longest paths emanate from particle placement at mid-level in layer 3, and are approximately 33,000 m, which is much longer than the length at which further increases in dispersivity with length became negligible, 1000 m (Xu and Eckstein, 1995). Because the flow paths in this model domain vary from less than 100 m to as much as 33,000 m, setting dispersivity for 1000 m is reasonable and avoids changing D for each source. The apparent longitudinal dispersivity therefore is 11.8 m. The transverse and vertical dispersivity equals 0.2 and 0.1 times the longitudinal dispersivity (Schulze-Makuch et al., 1999). This analysis treats sulfate as conservative to estimate the sources which could have the most significant impacts without relying on estimates of reactivity to attenuate the risk.

2.5. Flow model calibration

Steady state calibration is the process of adjusting *K* and boundary reach conductance so that simulated steady state groundwater levels match observed target groundwater levels and that simulated boundary fluxes equal measured fluxes (Anderson and Woessner, 1992). Within the four study area watersheds, the groundwater level database (MN Geological Survey and MN Department of Health, http://www.mngeo.state.mn.us/chouse/metadata/wells.html) contained 1238 wells with 362 having depth to water, water level elevation, well depth, and depth to bedrock (Fig. 3). There are few groundwater level measurements in the headwaters of the Isabella River and Kawishiwi River watershed, so nine artificial targets weighted 0.3 were set there in each model layer with head set equal to ground surface elevation minus 4 m, similar to methods of Halford and Plume (2011).

Calibration was deemed sufficiently reliable for comparative testing of the siting of contaminant sources (Nordstrom, 2012) when continued parameter estimation yielded composite scale sensitivity (CSS) within a few orders of magnitude for all parameters (Hill and Tiedeman, 2007), the parameter estimates ceased changing during automated calibration, and the sum of squared residuals (SSR) and actual mean residual was at a minimum.

2.6. Flow path simulation

Advective pathways from the mineral leases (Fig. 2) to respective discharge points, a DRAIN boundary, were determined and timed using MODPATH (Pollock, 1994). Contaminant particles were placed in approximately 630 model cells coincident with mineral leases (Fig. 2) at five different levels – the middle and top of layer 3 and the middle and top of layer 2 to represent contaminants leaching from underground, and the top of layer 1, or the water table, to represent surface leaks through the vadose zone.

2.7. Transient model scenarios

The modeling scenarios are generic but representative of mining which could occur in this area (Parker and Eggleston, 2014; Polymet Mining, 2013a) with relatively stringent and well-enforced regulations. The simulated contaminant loads are similar to values expected for waste at the nearby proposed Polymet mine (Polymet Mining 2013a, 2013b, 2013c, 2012) because the ore is of similar sulfide content and the hydrogeology is also similar. The two model scenarios include one for which waste is backfilled into underground workings and one for waste piled onto the ground surface where leaching can occur. Model simulations were transient, with a one-year period (20 time steps with 1.2 multiplier) of waste input, as described below, and a 1000-year period (60 time steps, 1.1 multiplier) of long-term transport. The one-year period of contaminant injection is conservative because if engineering plans go wrong or a leak goes undetected, the contaminant source could continue for much longer. Groundwater fluxes continue as simulated in steady state except for the small amount of injection used to simulate the underground waste. Simulations do not consider mine dewatering or other water management activities.

Waste in underground workings oxidizes, but the rate decreases manyfold after the water level recovers and saturates the waste (Demchak et al., 2004; Kohfahl et al., 2004). As the water level recovers, it flows through the waste leaching a contaminant load into the surrounding groundwater. To simulate this leaching as a sulfate load to groundwater, a low-flow (60 m^3/d), high-concentration (10,000,000 μg/l, based on concentrations expected at the nearby proposed Polymet mine (Polymet Mining, 2013a, 2013c)), injection well was placed within each of five model cells in model layers 2 and 3 at five locations representative of the mineral leases (Fig. 2). The placement of a sulfate source at different levels and locations allows consideration of the sensitivity of the flow paths emanating from the different locations of backfilled waste. The one-year period accounts for the probable short-term cessation of oxidation as groundwater levels recover.

Above-ground sources, waste dumps, are simulated as a 10,000,000 μg/l concentration added to the natural recharge over six cells located as for the underground sources. This concentration is an order of magnitude higher than observed in the field for similar ore (Lapakko and Olson, 2015), but justified because the samples in that paper were taken downstream of the source after some dilution. The one-year simulation period is the equivalent of the operator developing a waste rock storage area and covering it after discovering a leak, completing reclamation over a one-year time period, or moving the waste to a different location. Total load varies from 2,847,000 kg to 2,573,250 kg depending on cell size.

3. Results and discussion

3.1. Calibration

The final SSR was 4405 and 2173 for unweighted and weighted targets, respectively. The standard deviation is 4.2% and 3.0% of the 150-m range in observations, from the lowest to highest groundwater elevation. There is no detectable trend with observed groundwater elevation and simulations should yield no bias. Final Ks for parameter zones (Fig. 7) are shown in Table 1.

Some of the wells cluster so closely (Fig. 3) they represent essentially the same information, so they were thinned, first by keeping just one well per layer within 200 m of each other, and second by keeping just one well per model cell with the head target equal to average head of the wells remaining after the first thinning (Wellman and Poeter, 2006).

Zones with few head observations were not sensitive so the final parameter values were selected on formation type and on values necessary to generate reasonable head values (ASTM, 1998). Horizontal conductivity (Kh) values in the surficial aquifer are high but within the observed values and vertical conductivity (Kv) values reflect highly stratified till. Each bedrock formation *K* varies over at least two orders of magnitude. Conductivity decreases with depth for most formations as expected due to compaction occurring due to overburden and less weathering with depth. In zones 32 and 3, Kh was much less than Kv (Table 1) which reflects a tendency for vertical flow in the upthrust Duluth Complex (Miller et al., 2002).

Simulated heads generally show groundwater movement from southeast to the north and northwest. The water table in the upper layer follows the irregular topography while in the deep layer contours reflect a consistent slope to the northwest with an upward gradient from layer 3 toward Birch Lake in the northwest portion of the study area near its primary surface water outlet (Figs. 3 and 8).

Recharge (Fig. 6) and simulated discharge were nearly equivalent in the Isabella and Stony River watersheds but varied by from 10% to 20% in the other watersheds due to interbasin groundwater flow. Percent differences among watersheds are small and indicate that the distribution of recharge and discharge through the model domain is accurate. All ten river reaches gain more flow in their lower reaches near their outlet due to converging flow. Ten simulated lakes received zero discharge because their bottom was above the water table which reflects their location in the upper recharge portions of the watersheds.

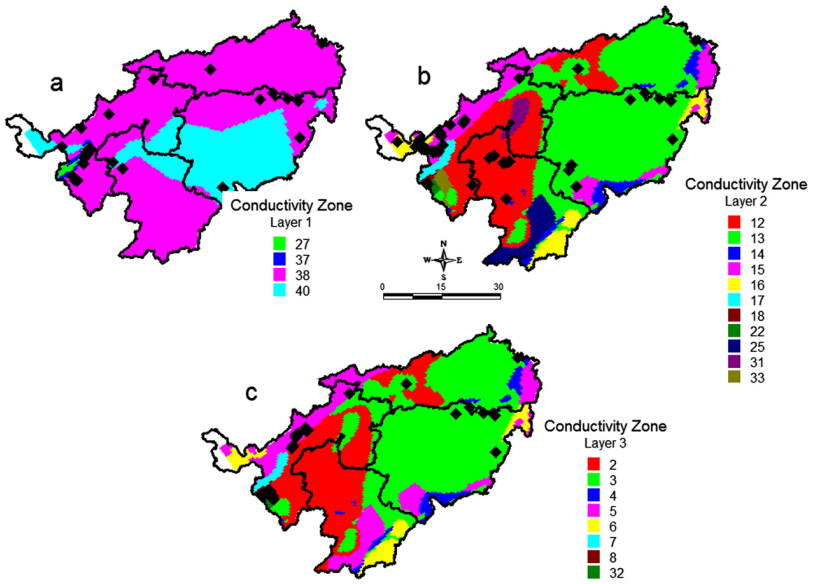


Fig. 7. Hydrogeology zones for three layers and steady state head target locations (black squares). Table 1 shows final conductivity values.

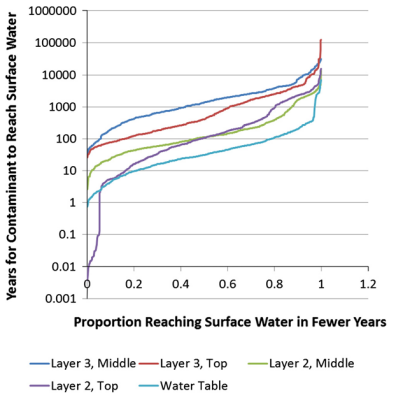


Fig. 8. Proportion of particles reaching surface water sources in a number of years for any location in the specified layer.

3.2. Particle tracking

Particles introduced at the middle level of layer 3, or about 750 m bgs, required the longest and those introduced at the water table required shortest time to reach surface water (Fig. 8), with minimum times varying from 26 years to less than a year, depending on layer. About 2.8% and 23.5% of the particles released at the top of layer 3 and middle of layer 2 reached surface water in less than 50 years, respectively (Figs. 8 and 9). Flow paths are longest through layer 3 because of the layer's thickness. The shortest pathways occur where a river boundary is close and there is an upward gradient, such as near Birch Lake (Figs. 3 and 9).

The shortest pathways, requiring less than two years, were from water table sources starting close to rivers (Fig. 9). Most particles reached surface water quickly, with 21% reaching surface water within 10 years and 62.9% in 50 years (Fig. 8). Longer transport times were for particles being transported deeply into layer 2 or 3 (Fig. 9).

The primary control on transport time, other than distance from the sink, is whether the particle sinks deeper into the bedrock (Gburek and Folmar, 1999), which would result from normal groundwater circulation. Contaminants released where they sink would present a less substantial risk to downstream resources. However, long pathways could result in contamination remaining a risk long after mining has ceased if it does not attenuate.

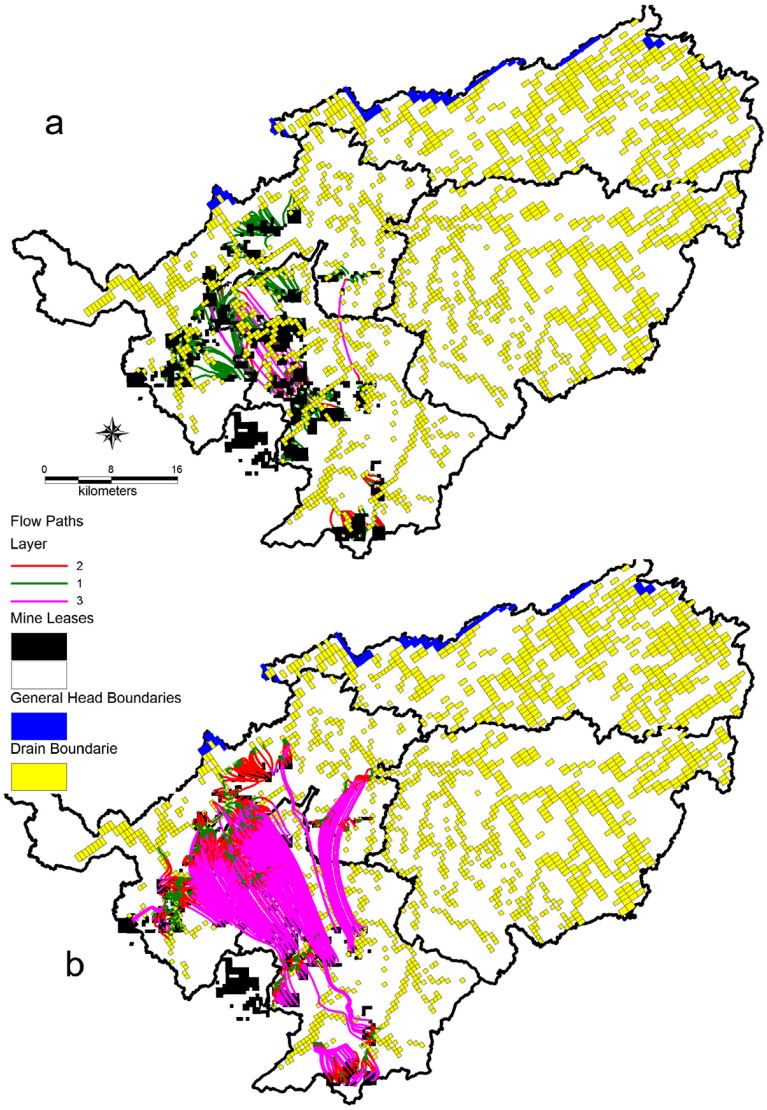


Fig. 9. Particle tracking for particles introduced at model cells near the mineral leases at the water table (a) or the top of layer 3 (b).

3.3. Contaminant transport modeling

Detectable sulfate, at 1 μg/l, expanded through the groundwater domain variously depending on the location of the source (Fig. 10). Sulfate from deep sources flows to the northwest with various amounts of lateral and vertical dispersion (Fig. 10a and b). Detectable sulfate reached up to 2.5 km from the source with up to 1.5 km lateral dispersion (Fig. 10a). Near sources 1 and 2 (source numbers specified in Fig. 10a), vertical dispersion caused contours in the surface layer to almost mirror those in the source layer. Sulfate originating at depth transports further in a thousand years than does sulfate originating on the surface which is limited in extent by discharge to rivers (Fig. 10b).

Sulfate originating from surface sources disperses to the northwest from headwaters and radially from near-river sources (Fig. 10c). Sulfate from source 4 expanded to the northeast but was constrained from expanding to the south by a steep topographic slope (Fig. 10c). Between ten and a hundred years, the sulfate contours did not spread significantly (Fig. 10c) due to discharge to surface waters while concentrations near the source decreased by an order of magnitude.

The amount of groundwater affected depends on the source, flow paths and dispersion. Contaminants eventually reach surface water, but at widely varying travel times (Fig. 8). The load is most important with respect to discharge to the rivers, and peak loads reach the various river reaches at times depending on distance and whether the source is surface or underground (Table 3). Peak loads from underground sources reached rivers in from ten to forty years and from surface sources in less than five years (Table 3 and Fig. 8).

The highest sulfate loads from surface sources were up to two orders of magnitude higher than those from underground sources and reach their peak at rivers in the Stony River watershed at the end of the first year, reflecting their close proximity of the source to the rivers. Filson Creek receives the highest load which translates to a concentration of near 120,000 μg/l. Peak loads reach Birch Lake and Dunka River after two to five years but are lower than for Stony River and Filson Creek, due to dilution over the longer flow path. Surface leaks reach the streams quicker and have higher concentration due to there being much less attenuation due to the shorter flow paths.

Baseflow makes up as much as 70 percent of the flow in rivers in this area, so the simulated loads (Table 3) would not be significantly diluted during low flows. During critical low flow periods (Winterstein et al., 2007) the sulfate concentrations would equal that determined from the groundwater load and flux discharging to the rivers (Mayes et al., 2007; Runkel et al., 2013).

The sulfate loads reaching the rivers vary substantially based on the location and depth of the sources. Surface sources contribute load to rivers much sooner and with a higher peak than do underground sources. The load reaching the relatively close-by Birch Lake or Dunka River is much higher but also much shorter-lived

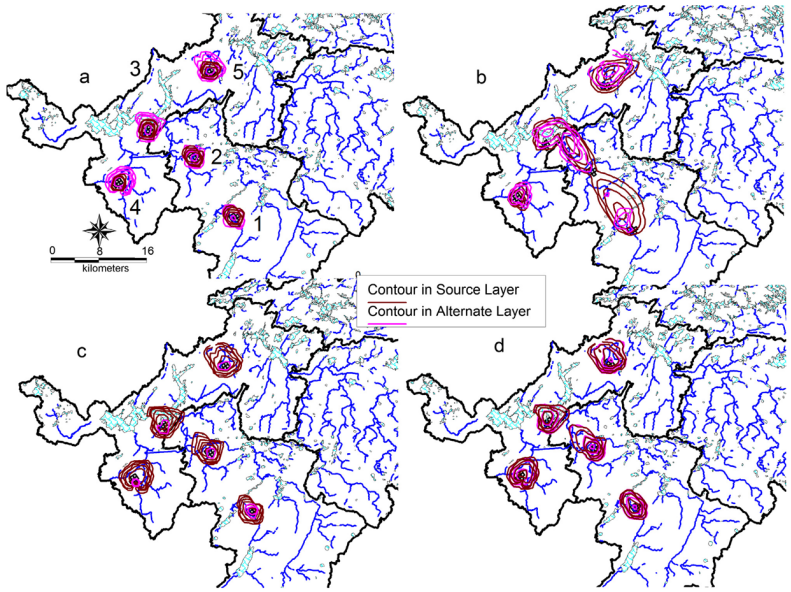


Fig. 10. Concentration contours for (a) underground source after 10 years, (b) underground source after 1000 years, (c) surface source after 10 years, and (d) surface source after 100 years. Underground source is layer 3, surface source is layer 1. Alternate layer is layer 1 in (a) and (b), layer 3 in (c), and layer 2 in (d). The contaminant source number is shown in (a). Contours range from 1 to 100,000 μg/l from outer to inner.

Table 3
Sulfate load (kg/day) discharging to reaches 1, 71, 72, 73, and 75 at various times corresponding to stress periods (1 or 2) and time step (number in parentheses). Steady state discharge to reach 1, 71, 72, 73, and 75 is −74,916, −73,295, −31,383, −168,050, and −11,439 m^3/d, respectively. The discharges are stated as a negative because they represent a loss from the groundwater domain. Reach 1 is Birch Lake, Reach 71 is Dunka River, Reach 72 is Stony River between Babbitt and Isabella, Reach 73 is Stony River above Isabella, Reach 75 is Filson Creek nr Ely, as shown in Fig. 3. Other reaches did not receive substantial load.

Period	Years	Reach				
		1	71	72	73	75
Deep sources						
1(20)	1	0.1	0.3	10.5	18.8	28.7
2(14)	10	12.4	14.9	38.7	43.0	45.6
2(21)	21.8	16.7	17.7	36.1	37.0	36.3
2(24)	30.2	17.5	18.1	32.7	32.9	31.3
2(27)	40.9	17.2	18.3	28.3	28.4	26.4
2(36)	99.4	9.9	15.3	12.2	12.4	11.9
2(60)	1000	1.3	0.3	0.0	0.2	2.2
Surface source						
1(20)	1	28.7	56.8	1033.5	1118.2	1378.2
2(1)	1.3	54.4	101.3	955.0	909.0	929.2
2(3)	2.1	115.2	184.2	782.6	589.4	524.5
2(5)	3	159.3	222.6	612.2	390.4	377.1
2(9)	5.5	161.7	192.8	313.1	187.7	211.1
2(11)	7.1	131.8	151.4	203.4	136.0	150.8
2(14)	10	86.9	94.3	105.0	90.2	93.9
2(21)	21.8	37.2	39.9	30.5	40.5	45.7
2(36)	99.4	8.2	25.4	10.1	15.0	15.2
2(60)	1000	0.0	0.0	0.0	0.0	0.0

than the load reaching the other rivers because distance slows the transport time assuring it will continue further into the future. Burying waste or placing it further from the resources to be protected will decrease the load reaching those rivers and substantially decrease the potential impacts of mining.

4. Conclusion

The reconnaissance-level fate and transport model presented herein simulates groundwater flows and estimates where, when, and at what concentration sulfate would discharge for various mine development scenarios in the Rainy Headwaters watershed. The model allows a comparison among sources to assess where mines and their associated waste facilities would cause less risk from spills and alternatively where mines could be riskier. Similar models should be developed for watersheds throughout the world that have substantial mineral deposits to prioritize development or alternatively to decide development is too risky. This type of model also shows where additional data should be collected, such as along the predicted pathways to reduce the uncertainty in advective flow rates and dispersion, a common need in most watersheds undergoing development (Caruso et al., 2008).

Groundwater with substantial contaminant concentrations discharges to streams whether sourced from deep underground or the ground surface. Even relatively short-term leaks on the surface could cause substantial loads to reach the rivers and valuable downstream resources. Longer-term leaks could cause peak concentrations reaching the rivers to be much higher than simulated herein. Underground sourced contaminant discharges last longer but have lower concentrations and are recommended for use in sensitive watersheds globally. In the Birch Lake watershed, leases trending southwest to northeast would discharge to surface water relatively quickly. Leases in the headwaters of the Stony River watershed would discharge to nearby surface water. These discharges would eventually coincide with critical low flow periods and cause potentially significant damage to rivers and the BWCAW.

Leaks into groundwater commence a long-term process in which contaminants travel to surface waters for a long time after the leaks have ceased discharging. Contamination may not be obvious until after a mine closes and impacts can continue for decades, with substantial concentrations still reaching rivers for hundreds of years even if the leaks cease. These factors should be considered when establishing bonds for long-term water quality remediation and modeling such as presented herein can be used to estimate the potential for future remediation.

Although mines are located based on the minerals, advance planning and analysis could avoid siting mine facilities where failure would cause too much natural resource damage. Reconnaissance-level modeling can provide the basis for more complete watershed-level studies as suggested to assess a watershed (von Guerard et al., 2007) and to determine where additional geochemical and hydrogeologic data should be collected (Caruso et al., 2008). Unless there is a clear geochemical sink for the contaminant, treating the transport as conservative will allow better decision making. Mine facilities should be located based on the potential for a leak or spill to damage downstream resources, as predicted with watershed-scale transport modeling. Such planning could lead to certification under responsible mining standards such as IRMA. Some areas should not be mined at all due to the risk to downstream resources.

Acknowledgements

This work was supported by Northeastern Minnesotans for Wilderness. The author thanks Rachel Garwin and Rebecca Rom for helpful comments and editing.

References

Anderson, M.P., Woessner, W.W., 1992. Applied Groundwater Modeling: Simulation of Flow and Advective Transport. Academic Press.

American Society for Testing and Materials (ASTM), 1998. Standard Guide for Comparing Ground-water Flow Model Simulations to Site-specific Information, Designation: D 5490-93. American Society for Testing and Materials, West Conshohocken, PA.

Bain, J.G., Blowes, D.W., Robertson, W.D., Frind, E.O., 2000. Modelling of sulfide oxidation with reactive transport at a mine drainage site. J. Cont. Hydrol. 41 (1–2), 23–47. http://dx.doi.org/10.1016/S0168-7722(99)00069-8.

Buxton, H.T., Nimick, D.A., von Guerard, P., Church, S.E., Frazier, A.G., Gray, J.R., Lipin, B.R., March, S.P., Woodward, D.F., Kimball, B.A., Finger, S.E., Ischinger, L.S., Fordham, J.C., Power, M.S., Bunck, C.M., Jones, J.W., 1997. A science-based, watershed strategy to support effective remediation of abandoned mine lands. In: Fourth International Conference on Acid Rock Drainage (ICARD) May 30–June 6, 1997, Vancouver, British Columbia, Canada.

Caldwell, J., Charlebois, L., 2010. Tailings impoundment failures, black swans, incident avoidance and checklists. In: Tailings and Mine Waste'10, Vail, Colorado, USA, pp. 33–39.

Caruso, B.S., Cox, T.J., Runkel, R.L., Velleux, M.L., Bencala, K.E., Nordstrom, D.K., Julien, P.Y., Butler, B.A., Alpers, C.N., Marios, A., Smith, K.S., 2008. Metals fate and transport modelling in streams and watersheds: state of the science and USEPA workshop review. Hydrol. Process. 22, 4011–4021. http://dx.doi.org/10.1002/hyp.7114.

Cherkauer, D.S., 2004. Quantifying ground water recharge at multiple scales using PRMS and GIS. Ground Water 42 (1), 97–110. http://dx.doi.org/10.1111/j.1745-6584.2004.tb2455.x.

Church, S.E., 1996. A watershed-scale approach to tracing metal contamination in the environment. Canadian Network of Toxicology Centres (CNTC), Metals in the Environment Workshop Report, Far Hills Inn, Val Morin, Quebec, October 21–22, 1996.

Church, S.E., von Guerard, P., Finger, S.E. (Eds.), 2007. Integrated Investigation of Environmental Effects of Historical Mining in the Animas River Watershed, San Juan County, Colorado, U.S. Geological Survey Professional Paper 1651.

Cox, J.J., Routledge, R.E., Krutzelmann, H., 2009. The Nokomis Project, Minnesota, USA, NI 43-101 Report. Scott Wilson Roscoe Postle Associates Inc.

Crews, J.E., 1973. Establishing priorities in mine drainage reduction a cost-effectiveness approach. Wat. Resour. Bul. 9 (3), 567–576. http://dx.doi.org/10.1111/j.1752-1688, 1973.tb01770.x.

Cummins, J.F., Grigal, D.F., 1980. Legend to Map, Soils and Land Surface of Minnesota 1980, Soil Series No. 110, Miscellaneous Publication 11. University of MN, Agricultural Experiment Station, St Paul, MN.

Delin, G.N., Healy, R.W., Lorenz, D.L., Nimmo, J.R., 2007. Comparison of local- to regional-scale estimates of ground-water recharge in Minnesota, USA. J. Hydrol. 334, 231–249. http://dx.doi.org/10.1016/j.jhydrol.2006.10.010.

Demchak, J., Skousen, J., McDonald, L.M., 2004. Longevity of acid discharges from underground mines located above the regional water table. J. Environ. Qual. 33, 656–668. http://dx.doi.org/10.2134/jeq2004.6560.

Environmental Protection Agency (EPA), 1994. Technical Document: Acid Mine Drainage Prediction. Office of Solid Waste, Special Waste Branch, Washington, DC.

Evans, D.M., Zipper, C.E., Donovan, P.F., Daniels, W.L., 2014. Long-term trends of specific conductance in waters discharge by coal-mine valley fills in central Appalachia, USA. J. Am. Wat. Resour. Assoc. http://dx.doi.org/10.1111/jawr.12198.

Ferderer, D.A., 1996. National overview of abandoned mine land utilizing the Minerals Availability System (MAS) and geographic information systems technology. US Geol Surv Open-File Report 96-549.

Fetter, C.W., 1999. Contaminant Hydrogeology, second ed. Prentice-Hall, Upper Saddle River, NJ.

Fetter, C.W., 2002. Applied Hydrogeology, fourth ed. Prentice-Hall, Upper Saddle River, NJ.

Gburek, W.J., Folmar, G.J., 1999. Patterns of contaminant transport in a layered fractured aquifer. J. Contam. Hydrol. 37, 87–109. http://dx.doi.org/10.1016/S0169-772(98)00158-2.

Gooseff, M.N., Bencala, K.E., Scott, D.S.T., Runkel, R.L., McKnight, D.M., 2005. Sensitivity analysis of conservative and reactive stream transient storage models applied to field data from multiple-reach experiments. Adv. Wat. Resour. 28, 479–492. http://dx.doi.org/10.1016/j.advwatres.2004.11.012.

Halford, K.J., Plume, R.W., 2011. Potential Effects of Groundwater Pumping on Water Levels, Phreatophytes, and Spring Discharges in Spring and Snake Valleys, White Pine County, Nevada, and Adjacent Areas in Nevada and Utah. US Geol Surv Scientific Investigations Report 2011-5032.

Harbaugh, A.W., Banta, E.R., Hill, C., McDonald, M.G., 2000. MODFLOW-2000, the US Geological Survey Modular Ground-water Model – User Guide to Modularization, Concepts and the Ground-water Flow Process. US Geological Open-File Report 00-92.

Heinselman, M., 1996. The Boundary Waters Wilderness Ecosystem. U Minn Press, St Paul, MN.

Herr, J.W., Chen, C.W., Goldstein, R.A., Herd, R., Brown, J.M., 2003. Modeling acid mine drainage on a watershed scale for TMDL calculations. J Am. Wat. Resour. Assoc. 39 (2), 289–300.

Hill, M.C., Tiedeman, C.R., 2007. Effective Groundwater Model Calibration: With Analysis of Data, Sensitivities, Prediction, and Uncertainty. Wiley and Sons.

Jacobs, J.A., Testa, S.M., 2014. Acid drainage and sulfide oxidation: introduction. In: Jacobs, J.A., Lehr, J.H., Testa, S.M. (Eds.), Acid Mine Drainage, Rock Drainage, and Acid Sulfate Soils: Causes, Assessment, Prediction, Prevention, and Remediation. Wiley and Sons (Chapter 1).

Jacobs, J.A., Lehr, J.H., Test, S.M., 2014. Acid Mine Drainage, Rock Drainage, and Acid Sulfate Soils: Causes, Assessment, Prediction, Prevention, and Remediation. Wiley and Sons.

Johnson, D.B., Hallberg, K.B., 2005. Acid mine drainage remediation options: a review. Sci. Total Environ. 338, 3–14. http://dx.doi.org/10.1016/j.scitotenv.2004.09.002.

Jones, P.M., Woodruff, L.G., Seal, R.R., Piatak, N.M., Hauck, S., Jennings, C.E., 2014. Assessing the influence of copper-nickel-bearing bedrocks on baseline water quality in three northeastern Minnesota watersheds. Presented at National Conference of Mining-Influenced Waters, Approaches for Characterization, Source Control and Treatment, Albuquerque NM, August 12–14, 2014.

Kimball, B.A., Bencala, K.E., Besser, J.M., 1999. Synthesis of Watershed Characterization for Making Remediation Decisions. US Geol Surv Water-Resource Investigations Report 99-4018A, pp. 3–7.

Kimball, B.A., Runkel, R.L., Walton-Day, K., Bencala, K.E., 2002. Assessment of metal loads in watersheds affected by acid mine drainage by using tracer injection and synoptic sampling: Cement Creek, Colorado, USA. Appl. Geochem. 17 (9), 1183–1207. http://dx.doi.org/10.1016/S0883-2927(02)00017-3.

Kimball, B.A., Church, S.E., Besser, J.M., 2006. Lessons learned from the US Geological Survey abandoned mine lands initiative – 1997–2002. In: Barnheisel, R.I. (Ed.), Proceedings of the 7th International Conference on Acid Rock Drainage (ICARD), St. Louis, MO, pp. 944–962.

Kohfahl, C., Hamann, E., Pekdeger, A., 2004. Estimating the effect of water table oscillations on acidification using a hydraulic model. Appl. Earth Sci. 113. http://dx.doi.org/10.179/03717450422504466.

Kuipers, J.R., Maest, A.S., MacHardy, K.A., Lawson, G., 2006. Comparison of Predicted and Actual Water Quality at Hardrock Mines: The reliability of predictions in Environmental Impact Statements. EARTHWORKS, Washington, DC.

Land Management Information Center, 1996. MGC 100 Data Documentation. MN State Planning Agency, St. Paul, MN.

Lapakko, K., 1988. Prediction of acid mine drainage from Duluth Complex mining wastes in northeastern Minnesota. In: Proceeding: 1988 Mine Drainage and Surface Mine Reclamation Conference, American Society for Surface Mining and Reclamation, US Department of the Interior, April 17–22, 1988, Pittsburgh, pp. 180–190.

Lapakko, K., Olson, M., 2015. Scaling laboratory sulfate release rates to operations waste rock piles. Presented at: 10th International Conference on Acid Rock Drainage and IMWA Annual Conference.

Lefebvre, R., Hockley, D., Smolensky, D., Gelinas, P., 2001. Multiphase transfer processes in waste rock piles producing acid mine drainage 1: conceptual model and system characterization. J. Cont. Hydrol. 52, 137–164. http://dx.doi.org/10.1016/S0169-7722(01)00156-5.

Leshy, J., 1987. The Mining Law: A Study in Perpetual Motion. Resources for the Future, Washington.

Lim, K.J., Engel, B.A., Tang, Z., Choi, J., Kim, K.-S., Muthukrishnan, S., Tripathy, D., 2005. Automated web GIS based hydrograph analysis tool, WHAT. J. Am. Wat. Resour. Assoc. 41 (6), 407–1416. http://dx.doi.org/10.1111/j.1752-1688.2005.tb03808.x.

Lim, K.J., Park, Y.S., Kim, J., Shin, Y.C., Kim, N.W., Kim, S.J., Jeon, J.H., Engel, B.A., 2010. Development of genetic algorithm-based optimization module in WHAT system for hydrograph analysis and model application. Comp. Geosci. 36 (7), 936–944, doi.10.1016/j.cageo.2010.01.004.

Lorenz, D., Delin, G.N., 2007. A regression model to estimate regional ground water recharge. Ground Water. 45 (2), 196–208, doi.10.1111/j.1745.6584.2006.00273.

Lottermoser, B., 2010. Mine Wastes: Characterization, Treatment and Environmental Impacts. Springer, 397p.

Mast, M.A., Turk, J.T., 1999. Environmental Characteristics and Water Quality of Hydrologic Benchmark Network Stations in the West-Central United States, 1963-95. U.S. Geol. Surv. Circular 1173-B.

Mayes, W.M., Gozzard, E., Potter, H.A.B., Jarvis, A.P., 2007. Quantifying the importance of diffuse mine water pollution in a historically heavily coal mined catchment. Environ. Pollut. 151 (1), 165–175. http://dx.doi.org/10.1016/j.envpol.2007.02.008.

Miller Jr, J.D., Green, J.C., Severson, M.J., Chandler, V.W., Hauck, S.A., Peterson, D.M., Wahl, T.E., 2002. Geology and Mineral Potential of the Duluth Complex and Related Rocks of Northeastern Minnesota. MN Geol. Surv. Report of Investigations 58.

Minnesota Department of Natural Resources (MNDNR), 2014. State Mineral Interest and Metallic Minerals Leasing in Northern Minnesota as of July 21, 2014. <http://files.dnr.state.mn.us/lands_minerals/mineral_faq/mn_mininterests_07212014.pdf, accessed 11/6/2014>.

Myers, T., 2013. Remediation scenarios for selenium contamination Blackfoot Watershed southeast Idaho, USA. Hydrogeol. J. http://dx.doi.org/10.1007/s10040013-0953-8.

Nash, J.T., Fey, D.L., 2007. Mine Adits, Mine-Waste Dumps, and Mill Tailings as Sources of Contamination. In: Church, S.E., von Guerard, P., Finger, S.E. (Eds.), Integrated Investigation of Environmental Effects of Historical Mining in the Animas River Watershed, San Juan County, Colorado, U.S. Geological Survey Professional Paper 1651 (Chapter E6).

Neal, C., Whitehead, P.G., Jeffery, H., Neal, M., 2005. The water quality of the River Carnon, west Cornwall, November 1992 to March 1994: the impacts of Wheal Jane discharges. Sci. Total Environ. 338, 23–39. http://dx.doi.org/10.1016/jj.scitotenv.2004.09.003.

Nicholson, S.W., Dicken, C.L., Foose, M.P., Mueller, J.A.L., 2007. Preliminary Integrated Geologic Map Databases for the United States: Minnesota, Wisconsin, Michigan, Illinois, and Indiana. U.S. Geol. Surv. Open-File Report 2004-1355.

Nimick, D.A., von Guerard, P., 1998. Science for Watershed Decisions on Abandoned Mine Lands: Review of Preliminary Results, Denver, Colorado, February 4–5, 1998. U.S. Geol. Surv. Open-File Report 98-0297.

Nordstrom, D.K., 2008. Questa Baseline and Pre-Mining Ground-Water Quality Investigation, 25. Summary of Results and Baseline and Pre-mining Groundwater Geochemistry, Red River Valley, Taos County, New Mexico, 2001–2005. U.S. Geological Survey Professional Paper 1728.

Nordstrom, D.K., 2011. Hydrogeochemical processes governing the origin, transport and fate of major and trace elements from mine wastes and mineralized rock to surface waters. Appl. Geochem. 26, 1777–1791. http://dx.doi.org/10.1016/j.apgeochem.2011.06.002.

Nordstrom, D.K., 2012. Models, validation, and applied geochemistry: issues in science, communication, and philosophy. Appl. Geochem. 27, 1899–1919, Doi 10.

Natural Resources Conservation Service (NRCS), 2007. Part 630 Hydrology National Engineering Handbook. Hydrologic Soil Groups. U.S. Dept. Agriculture, Natural Resources Conservation Services, Washington, D.C. (Chapter 7).

Parker, H.P., Eggleston, T., 2014. Duluth Metals Limited, Maturi, Maturi Southwest, Birch Lake, and Spruce Road Cu-Ni-PGE Projects, Ely, Minnesota USA, NI 43-101 Technical Report, Project Number 175829. Prepared for Duluth Metals. Duluth, MN.

Pollock, D.W., 1994. User's guide for MODPATH/MODPATH-PLOT, version 3: a particle-tracking post-processing package for MODFLOW, the US Geological Survey finite-difference ground-water flow model. U.S. Geol. Surv. Open-File Report 94-464.

Polymet Mining, 2012. NorthMet Project, Rock and Overburden Management Plan, Version 5. December 28, 2012.

Polymet Mining, 2013a. NorthMet Project, Project Description, Version 5, March 7, 2013.

Polymet Mining, 2013b. NorthMet Project, Waste Characterization Data Package, Version 10. March 7, 2013.

Polymet Mining, 2013c. NorthMet Project, Water Modeling Data Package, Volume 1 – Mine Site, Version 11. March 8, 2013.

Rawls, T.J., Brakensiek, W.K., Saxton, K.E., 1982. Estimation of soil water properties. Trans. Am. Soc. Agr. Eng. 25, 1316–1320.

Rico, M., Benito, G., Salgueiro, A.R., Díez-Herrero, A., Pereira, H.G., 2008. Reported tailings dam failures: a review of the European incidents in the worldwide context. J. Hazard. Mater. 152 (2), 846–852. http://dx.doi.org/10.1016/j.jhazmat.2007.07.050.

Runkel, R.L., Kimball, B.A., 2002. Evaluating remedial alternatives for an acid mine drainage stream: application of a reactive transport model. Environ. Sci. Technol. 36, 1093–1101.

Runkel, R.L., Walton-Day, K., Kimball, B.A., Verplanck, P.L., Nimick, D.A., 2013. Estimating instream constituent loads using replicate synoptic sampling, Peru Creek, Colorado. J. Hydrol. 489, 26–41. http://dx.doi.org/10.1016/j.jhydrol.2013.02.031.

Scanlon, B.R., Healy, R.W., Cook, P.G., 2002. Choosing appropriate techniques for quantifying groundwater recharge. Hydrogeol. J. 10, 18–39. http://dx.doi.org/10.1007/s10040-0010176-2.

Schulze-Makuch, D., Carlson, D.A., Cherkauer, D.S., Malik, P., 1999. Scale dependence of hydraulic conductivity in heterogeneous media. Ground Water 37 (6), 904–919. http://dx.doi.org/10.1111/j.1745-6584.1999.tb01190.x.

Seal, R., Lapakko, K., Piatak, N., Woodruff, L., 2015. Reaction modeling of drainage quality in the Duluth Complex, Northern Minnesota, USA. Presented at 10th International Conference on Acid Rock Drainage and IMWA Annual Conference.

Severson, M.J., Miller, J.D., Peterson, D.M., Green, J.C., Hauck, S.A., 2002. Chapter 8: Mineral potential of the Duluth Complex and related intrusions. In: Miller, J.D., Green, J.C., Severson, M.J., Chandler, V.W., Hauck, S.A., Peterson, D.M., Wahl, T.E., (Eds.), Geology and Mineral Potential of the Duluth Complex and Related Rocks of Northeastern Minnesota. MN Geol Surv Report of Investigations 58.

Siegel, D.I., 1981. The effect of snowmelt on the water quality of Filson Creek and Omaday Lake, northeastern Minnesota. Wat. Resour. Res. 17, 238–242. http://dx.doi.org/10.1029/WR017i001p00238.

Siegel, D.I., Ericson, D.W., 1981. Hydrology and Water Quality of the Copper-Nickel Study Region, Northeastern Minnesota. U.S. Geol. Surv. Water-Resour. Investigations 80-739 Open File Report. St Paul, MN.

Siegel, D.I., Reeve, A.S., Glaser, P.H., Romanowicz, E.A., 1995. Climate-driven flushing of pore water in peatlands. Nature 374 (6), 531–533. http://dx.doi.org/10.1038/374531a0.

Skousen, J.A., Rose, A., Geidel, G., Foreman, J., Evanns, R., Hellier, W., 1999. Handbook of Technologies for Avoidance and Remediation of Acid Mine Drainage. Natl. Mine Land Recl. Ctr, Morgantown, WV.

Sophocleous, M., 2002. Interactions between groundwater and surface water: the state of the science. Hydrogeol. J. 10, 52–67. http://dx.doi.org/10.1007/s10040-001-0170-8.

Stark, J.R., 1977. Surficial Geology and Ground-water Geology of the Babbitt-Kawishiwi Area, Northeastern Minnesota with Planning Implications. MS Thesis, University of Wisconsin – Madison.

Thorleifson, L. (Ed.), 2008. Potential Capacity for Geologic Carbon Sequestration in the Midcontinent Rift System in Minnesota. MN Geol Surv.

Twin Metals Minnesota, 2014. Twin Metals Minnesota LLC Overview – Minnesota SME. Powerpoint Presentation. April 23, 2014.

US Geological Survey (USGS), US Department of Agriculture, Natural Resources Conservation Service, 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD): Techniques and Methods 11-A3. <http://pubs.usgs.gov/tm/11/a3/>.

von Guerard, P., Church, S.E., Yager, D.B., Besser, J.M., 2007. The Animas River Watershed, San Juan County, Colorado, Chapter B. In: Church, S.E., von Guerard, P., Finger, S.E. (Eds.), Integrated Investigation of Environmental Effects of Historical Mining in the Animas River Watershed, San Juan County, Colorado, USGS Professional Paper 1651.

Wellman, T.P., Poeter, E.P., 2006. Evaluating uncertainty in predicting spatially variable representative elementary scales in fractured aquifers, with application to Turkey Creek Basin, Colorado. Wat. Resour. Res. 42, W08410. http://dx.doi.org/10.1029/2005WR004431.

Williams, R.E., 1975. Waste Production and Disposal in Mining, Milling, and Metallurgical Industries. Miller Freeman Productions, Inc.

Winter, T.C., 1973. Hydrogeology of the Glacial Drift, Mesabi Iron Range, Northeastern Minnesota. U.S. Geol. Surv. Water-Supply Paper 2029-A.

Winter, T.C., 1998. Relation of streams, lakes, and wetlands to groundwater flow systems. Hydrogeol. J. 7, 28–45. http://dx.doi.org/10.1007/s100400050178.

Winterstein, T.A., Arntson, A.D., Mitton, G.B., 2007. Methods Used to Compute Low-flow Frequency Characteristics for Continuous-record Streamflow Stations in Minnesota, 2006. U.S. Geol. Surv. Open-File Report 2007-1033.

Xu, M., Eckstein, Y., 1995. Use of weighted least-squares method in evaluation of the relationship between dispersivity and field scale. Ground Water 33 (6), 905–908. http://dx.doi.org/10.1111/j.1745-6584.1995.tb00034.x.

Zheng, C., Wang, P.P., 1999. MT3DMS: a modular three-dimensional multispecies model for simulation of advection, dispersion and chemical reactions of contaminants in groundwater systems. Documentation and User's Guide, Contract Report SERDP-99-1, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Mr. STAUBER. I thank Ms. Rom for her testimony.
I now recognize Mr. Chura for 5 minutes.

STATEMENT OF DAVID CHURA, BOARD CHAIR, JOBS FOR MINNESOTANS, DULUTH, MINNESOTA

Mr. CHURA. Good morning, Chairman Stauber and members of the Committee. Thank you for the opportunity to testify today in support of Concurrent Resolution 34 and the Superior National Forest Restoration Act. My name is David Chura, and I am the Chair of Jobs for Minnesotans.

Jobs for Minnesotans is a unique, non-partisan coalition that brings together labor unions, businesses, and local communities. Our coalition was founded in 2012 by the Minnesota Building and Construction Trades Council, as well as the Minnesota Chamber. We are committed to the principle that Minnesota can both create jobs and protect the environment.

I am the grandson of an immigrant miner, and I have witnessed firsthand the impact and difference a good job in the mining industry can make for families and communities. I have also watched the mining industry transform into the modern, responsible, and sustainable practices that they implement today.

Our workers are skilled, they are professional, and they prioritize safety, communities, and the protection of the environment.

Jobs for Minnesotans encourages Congress to exercise its authority to overturn the withdrawal of 225,000 acres of the Superior National Forest from future leasing and exploration and development activities. The withdrawal was unnecessary.

The BWCA, a place that I love and where I have another trip planned for this July, already has strict protections in place both within its boundaries as well as buffer zone surrounding it where no mining can occur. The Administration should rely on studying site-specific project proposals. The withdrawal is simply saying no to any and all projects, instead of using scientific inquiry and a public process to determine the outcome.

By overturning the withdrawal and reinstating leases that were in place for more than 50 years and 10 presidential administrations, you aren't giving blanket approval for mining. If a mine can't show that it can meet or exceed standards to operate safely and responsibly, it shouldn't be permitted. However, instead of a generic ban that chills investment and exploration and deepens our dependence on imports, projects should be allowed to follow a timely, predictable, and transparent regulatory and environmental review process.

The arbitrary withdrawal is a statement of distrust. It appears the Interior Department does not trust its own scientific process that has regulated and protected this nation for decades, nor trust in the employees at Federal agencies to review the environmental impacts of a specific project.

Additionally, this ban is for 20 years, preventing any companies from pursuing exploration or development at a time when demand for critical minerals is skyrocketing. It is paramount for the United States to have access to a secure domestic source of metals, especially nickel and cobalt, minerals that are critical to U.S.

manufacturing, infrastructure, clean energy, and battery storage technology.

According to the International Energy Association, since 2010, the average amount of minerals needed for a new unit of power has increased by 50 percent. The transition to cleaner energy means a shift from a fuel-intensive to a very mineral-intensive system. Domestically sourcing those minerals provides job, economic, energy, and national security for Americans.

The Duluth Complex is a domestic mineral resource needed to advance the clean energy transition. Mining has been the lifeblood of this region for over 140 years, and has existed in harmony with our other core businesses such as forest products, transportation, health care, education, and tourism. Further, it has existed all the while protecting the environment.

We should allow our mining workers and investors the opportunity to scientifically prove they can safely mine for minerals and protect the surrounding environment by following the extensive environmental review process. The economic opportunities are significant: an unprecedented level of investment that will revitalize the entire region, strengthening our families, schools, hospitals, and more.

The minerals needed for a cleaner tomorrow will come from someplace. We should all want those minerals to come from operations where we, as Americans, have a say in the regulatory process, where we have strong safety and environmental requirements and oversight of mining operations. Supporting these bills means supporting scientific review of specific projects; supporting family-sustaining, middle-class jobs; and the strengthening of our vital local communities.

Thank you for the opportunity to testify today.

[The prepared statement of Mr. Chura follows:]

PREPARED STATEMENT OF DAVID T. CHURA, BOARD CHAIR, JOBS FOR MINNESOTANS

ON CONCURRENT RESOLUTION 34 AND H.R. 3195, "SUPERIOR NATIONAL FOREST RESTORATION ACT"

Thank you for the opportunity to testify in support of House Concurrent Resolution 34 and the Superior National Forest Restoration Act. Jobs for Minnesotans is a unique non-partisan organization that brings together labor unions, businesses, and local communities. Our coalition was co-founded in 2012 by the Minnesota Building and Construction Trades Council and the Minnesota Chamber of Commerce. Jobs for Minnesotans represents 70,000 union workers, over 2,300 members of the Minnesota Chamber and hundreds more local chamber members, elected leaders and residents of the state. The organization is committed to the principle that Minnesota can both create jobs and protect the environment for future generations.

I am the grandson of an immigrant coal miner and I have witnessed first-hand the difference a good job in mining can make for families and communities. Unlike seasonal tourism jobs in the region where peak employment is less than four months of the year, mining provides year-round, family-sustaining careers that consistently put food on the table and provide post-secondary education opportunities for their kids.

I have also watched the mining industry transition to the modern, responsible, and sustainable practices of today. Our workers are skilled, professional and they prioritize safety, communities, and the protection of the environment. The mines that have been proposed in the region are not the mines of the 19th century. The companies proposing projects aim to leverage global state-of-the-art technology that they want to prove can both protect the environment and responsibly create jobs.

Jobs for Minnesotans encourages Congress to exercise its authority to overturn the Department of Interior's withdrawal of 225,000 acres of the Superior National Forest from future leasing and exploration and development activities.

The withdrawal was unnecessary. The Boundary Waters Canoe Area Wilderness, a place I love and where I have another trip planned for in July, already has strict protections in place within its boundaries as well as buffer zones surrounding it where mining is prohibited. The Administration should rely on studying a site-specific project proposal. Every mine is unique and specific to its leases, location, and mining methods. Every geological deposit the proposal sits on is different and should be evaluated individually based on merit. The withdrawal is simply saying "no" to any and all projects instead of using scientific inquiry and a public process to determine the outcome.

Without the withdrawal, the below federal and state regulations exist to protect the Boundary Waters Canoe Area Wilderness. Congress, the Minnesota Legislature, state and federal government agencies, environmental groups, mining and exploration companies, and mineral owners have spent decades conducting the research, working on laws and regulations, and establishing the permitting processes to assure that development of copper, nickel, and other nonferrous minerals in Minnesota will be managed responsibly:

- Mining was banned in the BWCAW by the Wilderness Act of 1964. The 1978 Boundary Waters Canoe Area Wilderness Act created an additional mining ban in the 220,000-acre "Mining Protection Area" to create a buffer around the BWCAW area.
- In 1976, the State of Minnesota adopted Minnesota Statutes Section 84.523 prohibiting all mining within the BWCAW while expressly allowing ongoing mineral exploration and development outside of the protected areas. The Superior National Forest Plan identifies mining as a desired condition.
- Since 1967, Minnesota state leases for nonferrous minerals have required that lessees meet all state and federal regulations (including requirements of U.S. Forest Service and Bureau of Land Management) on federal and state surface land, use good environmental engineering practices, receive approval from the DNR commissioner for surface use, notify surface owners in advance of activities requiring use of the surface of leased premises, and retain responsibility for damages.
- In 1971, the state legislature passed the Minnesota Environmental Rights Act (MERA)
- In 1973, the state legislature passed the Minnesota Environmental Policy Act (MEPA) and the related rules that contain provisions specifically requiring review of mining projects.
- The Minnesota Legislature enacted a law (1980) and DNR subsequently adopted rules to regulate drillers of exploratory borings.
- The DNR adopted mineland reclamation rules for iron mining (1981) and nonferrous mining, including copper-nickel (1993), after public hearings and comments. The nonferrous mining rules extended the mining ban beyond the BWCAW to the "Boundary Waters Canoe Area Wilderness Mineral Management Corridor" including a 1/4-mile-minimum mining-free buffer around the BWCAW.
- Minnesota passed the Wetland Conservation Act (1991) and associated regulations, require wetlands replacement and setting aside certain significant peatlands.
- The Legislature required financial assurance for nonferrous mines, and DNR enacted new financial assurance rules (1993).

By overturning the withdrawal in the Superior National Forest and reinstating leases that were in place for more than 50 years and 10 presidential administrations, you aren't giving blanket approval for mining. If a mine can't show it can meet or exceed standards to operate safely and responsibly—it shouldn't be permitted. However, instead of a generic ban that chills investment and exploration and deepens our dependence on imports, projects should be allowed to follow a timely, predictable, and transparent regulatory and environmental review process.

The arbitrary withdrawal is a statement of distrust. It appears the Interior Department does not trust its own scientific process that has regulated and protected this nation for decades nor trust in the employees at Federal agencies to review the environmental impacts of a specific project. Additionally, this ban is for 20 years, preventing any companies from pursuing exploration or development at a time when demand for critical minerals is skyrocketing.

It's paramount for the U.S. to have access to a secure, domestic source of metals, especially nickel and cobalt—minerals that are critical to U.S. manufacturing, infrastructure, clean energy and battery storage technology. According to the International Energy Association, since 2010 the average amount of minerals needed for a new unit of power has increased by 50% as renewables increase their share of total capacity additions. The World Bank predicts the global need for copper over the next 25 years will be equal to the amount of copper mined in total over the last 5,000 years. The amount of nickel used per electric car could go from 20 kg to 40–50 kg by 2025, more than doubling the need. Annual global cobalt consumption is expected to reach 220,000 tons in 2025, increasing to 390,000 tons in 2030. That's almost double.

The transition to clean energy means a shift from a fuel-intensive to a mineral-intensive system. Domestically sourcing those minerals provides job security, economic security and national security for Americans.

The Duluth Complex in northeast Minnesota is a domestic clean energy mineral resource needed to advance the clean energy transition. Mining has been the lifeblood of this region for over 140 years, supporting workers and communities with safe, family sustaining jobs. It has existed in harmony with our other core industries of forest products, transportation, health care, education and tourism. Further, it has existed all while protecting the environment. We should allow our mining workers and investors the opportunity to scientifically prove they can both safely mine for minerals AND protect the surrounding environment, by following the extensive environmental review process.

Mining has existed in the Rainy River Basin (in Minnesota, Ontario and Manitoba) for most of the last century, including a significant number of historic nonferrous mines and several operating or permitted nonferrous mines. During this time, mining has co-existed with wilderness and recreation, with 43 historic mine sites (including 18 nonferrous mines) located within 10 miles of the Quetico Provincial Park and Boundary Waters Canoe Area Wilderness.

The economic opportunities are significant. An unprecedented level of investment that will revitalize the entire region—strengthening families, schools, hospitals and more. With the enactment of the withdrawal, our region now has experienced the loss of $1.5 billion in annual wages, and more than $2.5 billion in annual economic production based on studies conducted by the University of Minnesota Duluth.

The minerals needed for a cleaner tomorrow will come from someplace. We should all want those minerals to come from operations where we as Americans have a say in the regulatory process, where we have strong safety and environmental requirements and oversight of mining operations.

Ethical sourcing of copper, nickel, and other mineral resources goes beyond just mitigating environmental impacts. Mining here, at home, allows us to lessen our dependence on countries who have little to no regard for the environment, human life, and good wages. We have a moral obligation to explore mining here. And we have an obligation to protect and preserve our environments in the process. This isn't an either-or situation. We can, and need, to have both. In northeast Minnesota, mining will be done safely, with strict environmental and worker safety standards.

Currently, there is only one operating mine in the U.S. that produces nickel. The Eagle Mine in Michigan is also in a water-rich environment and has operated safely since 2014. It's also critical to understand that it currently takes a minimum 8–10 years to get a mining project through review and permitting, so we can't just wait until there are shortages.

Supporting these bills means supporting scientific review of specific projects, supporting family sustaining middle-class jobs and strengthening the vitality of local communities.

I thank you again for the opportunity to provide my testimony.

QUESTIONS SUBMITTED FOR THE RECORD TO MR. DAVID CHURA, CHAIR, JOBS FOR MINNESOTANS

Questions Submitted by Representative Stauber

Question 1. Mr. Chura, the minority-invited witness testified verbally and in writing that the mineral resources in the Duluth Complex are "insignificant". What is your understanding of the mineral value of the Duluth Complex?

Answer. The mineral value of the Duluth Complex is significant. In fact, in a presentation from Dr. Jim Miller, Department of Geological Sciences at the University of Minnesota Duluth, the copper-nickel precious mineral resources was described as "immense".[1] Recent estimates indicate the Duluth Complex contains nearly eight billion tons of ore, making it one of the world's largest undeveloped deposits.[2] Technical reports for six projects in the Duluth Complex disclose approximately: 28.1 million metric tons of copper, 8.3 million metric tons of cobalt. Putting those numbers in context, compared to other sources around the world, the Duluth Complex has both a significant concentration and volume of copper making it potentially one of the most productive sites in the world matched only by Sudbury (located in Canada) and Noril'sk (located in Russia).

The nickel concentrations are slightly lower than other deposits but there is significantly more volume of nickel in the Duluth Complex compared to other sites, making the Duluth Complex an extremely important source of nickel internationally, again, matched only by Sudbury and Noril'sk.[3]

Copper has been referred to as the life blood of green energy and plays a key role in the fight against climate change. S&P Global has predicted copper production will need to double by 2035 to meet demands driven by global net-zero emission goals. In it's best-case scenario, S&P Global estimates production from global mines will be 3.5 billion pounds short of meeting copper demands in 2035.[4] All deposits are important and needed in order for our country to meet the growing demand for the critical minerals required to achieve the clean energy transition.

It's also important to note that as an example of a project proposed in the withdrawal area, Twin Metals Minnesota, is ranked in the top ten biggest nickel projects in the world. That is significant.[5]

Finally, Department of Energy Secretary Granholm chastised "Not In My Backyard" attitudes that slow clean energy infrastructure. "Our backyard is now everybody's backyard," she told attendees at an Infrastructure Week event. Granholm noted there's been a "sea change" in the "permission that the administration has given for folks on the left to be able to say, 'Yes, we can respect our environmental laws, and we can move quickly at the same time.'"[6]

Question 2. Can you elaborate on the labor organizations represented by Jobs for Minnesotans, and their position on the H. Con. Res. 34 and the Superior National Forest Restoration Act?

Answer. Labor organizations on the board of Jobs for Minnesotans includes:

- North Central States Regional Council of Carpenters
- Minnesota Building & Construction Trades Council
- Laborers' International Union of North America—LiUNA!
- International Union of Operating Engineers Local 49
- Minnesota Pipe Trades Association

In addition to the comments provided by the labor union, business and local communities coalition—Jobs for Minnesotans—in support of H. Con. Res. 34 and the Superior National Forest Restoration Act, I am aware that the International Union of Operating Engineers Local 49 also sent a separate letter expressing support for H. Con. Res. 34.

---

[1] https://mn.water.usgs.gov/projects/tesnar/2011/Presentations/MillerDC%20Min_USGS%20workshop.pdf.

[2] https://www.mesabitribune.com/mine/minnesota-has-themetals-for-ev-green-energy-economy/article_810ada2c-7646-11eb-bb2c-bb7589cbe044.html.

[3] O. Roger Eckstrand & Larry J. Hulbert, Magmatic Nickel-Copper-Platinum Group Element Deposits, in Mineral Deposits of Canada 205, 205–06 (Wayne Goodfellow ed., 2007).

[4] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/071422-world-copper-deficit-could-hit-record-demand-seen-doubling-by-2035-s-p-global.

[5] https://www.mining.com/featured-article/ranked-worlds-biggest-nickel-projects/.

[6] https://subscriber.politicopro.com/newsletter/2023/05/gop-floats-breaking-up-permitting-talks-00097279.

Question 3. Although we do have tourism jobs in Minnesota, they are largely seasonal. In your experience, do the seasonal jobs offered up as alternatives to mining jobs provide family-sustaining and economy-growing wages?

Answer. Tourism is an integral part of our culture in northern Minnesota, but our diverse economy's foundation is supported by high paying mining jobs. According to 2022 data from the Minnesota Department of Employment and Economic Development, the average annual wage for tourism workers is $26,553, while the average wage for miners is $114,262.[7] Mining jobs are family and community sustaining wages that will help the local economy through spending in a variety of sectors: local businesses, hospitality, recreation, healthcare services, and more. They also support key public services and local medical care facilities. Jobs in mining bring families into restaurants, consumers into shops and students into local schools. These students and young adults are also needed to help staff up the seasonal jobs in the tourism industry. To see the health of any community, it is important to look beyond the census numbers. A healthy community has a robust K-12 system. Ely used to have around 150 kids in a grade. This year Ely's 9th grade had 33 students and the 10th grade had 32 students.

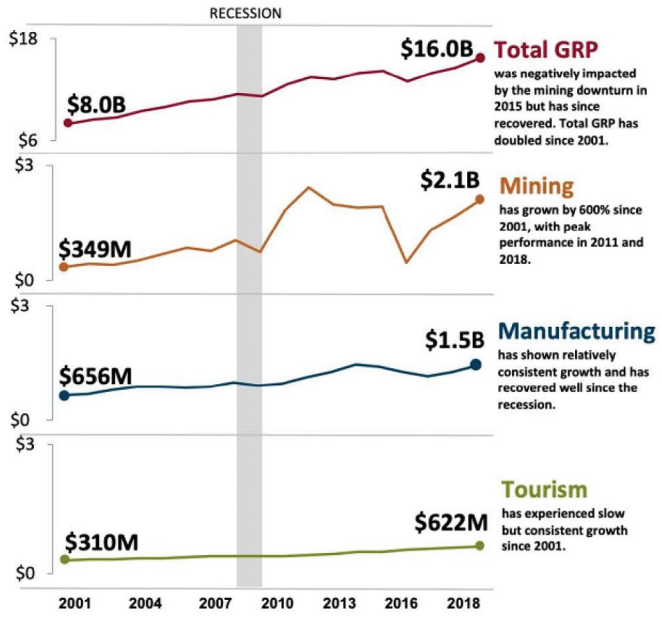
The 750 full-time jobs and the additional spinoff jobs created by the Twin Metals project may not sound like a lot to someone living in an urban area, but for the communities of northeast Minnesota where these jobs will be located, these jobs mean everything. Using the current population of Ely and Babbitt as a benchmark, the full-time and spinoff jobs from the proposed project could employ nearly half of the local population with wages that are, on average, 123 percent higher than the average annual wage in the region. Further, these jobs represent the opportunity for graduating high school students to stay in the area or for others to return home.

In Figure 5 below, you can see how mining's contribution to gross regional product (GRP) in the region has increased 600% since 2001 compared to the slow growth in tourism. Additionally, employment in mining increased 37% between 2009 and 2018. In comparison, the tourism industry experienced the slowest level of growth during the time period consistently, increasing from $310 million in 2001 to $622 million in 2018. Employment in the tourism related North American Industry Classification System (NAICS) code for "arts, entertainment, and recreation" only increased 3% and in "accommodation and food services", employment growth was just 7%.[8]

[7] https://mn.gov/deed/assets/2022_WDB3_RP_080222_tcm1045-264886.pdf.

[8] Table 1, PDF page 15 https://conservancy.umn.edu/bitstream/handle/11299/216463/UMD%20BBER%20Mining%20Economic%20Impact%20Report%202020.pdf?sequence=1&isAllowed=y.

Figure 5. Comparison of Duluth-Superior MSA GRP to Local Industries' GRPs



Source: Economic Impact of Ferrous and Nonferrous Mining on Minnesota and the Arrowhead Region, June 3, 2020 [9]

Mr. STAUBER. Thank you for your testimony, Mr. Chura.

I will now recognize the Members for 5 minutes of questioning, and I will recognize myself first.

Senator Bakk, thank you once again for joining us today. Ms. Rom's husband stated to the *New York Times* about miners, and I quote, "Resentment is the primary driver of the pro-mining crowd here. They are resentful that other people have come here and been successful, while they were sitting around waiting for a big mining company. They want somebody to just give them a job so they can all drink beer with their buddies and go four-wheeling and snowmobiling with their buddies, and not to have to think about anything except punching a clock."

Senator Bakk, do you agree that miners are driven only by resentment of the elites that oppose mining?

Mr. BAKK. Mr. Chairman, nothing could be further from the truth. Some of the hardest-working people in our country work in our mines and provide the raw materials and the steel that make our life possible. I have a son that works in one of the mines, a daughter-in-law that works in one of the other ones. And I find that statement offensive.

---

[9] Figure 5, PDF page 13 https://conservancy.umn.edu/bitstream/handle/11299/216463/UMD%20BBER%20Mining%20Economic%20Impact%20Report%202020.pdf?sequence=1&isAllowed=y.

But let me explain to you a little about Iron Rangers. They toil very hard in very tough weather conditions in blue collar jobs, very physical labor. So, when the weekend comes, they are not looking for strenuous outdoor recreation because they have a very strenuous job all week.They are looking for the kind of recreation that doesn't require strenuous activity, largely. And that is why there is a strong culture of motorized recreation in northeastern Minnesota, things like snowmobiles, I remind the Committee, were actually invented in Minnesota.

Mr. STAUBER. Yes.

Mr. BAKK. And all-terrain vehicles, which are produced in Minnesota, both Polaris and Arctic Cat, and Minnesotans produce them for all over the world. And boats and motors, Minnesota is one of the largest boat manufacturers in the entire nation.

And I think the culture is that of motorized recreation because the jobs are so physical during the week, and that is how people like to play and recreate. But I find it very offensive to characterize them as anything other than hardworking Minnesotans making a huge contribution to our country.

Mr. STAUBER. Thank you, Senator.

Dr. Thorleifson, great to see you again. The Democrat-invited witness testified that minerals in the withdrawal area are "insignificant." As a trained geologist with decades of experience, do you agree or disagree with Ms. Rom's characterization of the Duluth Complex as insignificant?

Dr. THORLEIFSON. Well, the production isn't going to give us instant mineral commodity self-sufficiency, but this is significant in many ways. The Duluth Complex is an immense resource on the world scene in terms of potential for nickel, copper, other elements. The production would be significant for people who have jobs in the mine. The production would be significant for the shareholders who have already invested a half-billion dollars.

So, if a rigorous environmental review demonstrates that not only will there be no impact downstream at the Boundary Waters, but downstream from the first mile, the metal production is significant for the nation. Thinking of copper, nickel, cobalt, platinum, for some of these elements this production from this mine would be as much as 5 percent of our consumption, as much as 10 percent of our imports.

If this is combined with two or three other mines in the country, as well as new domestic refining capacity, suddenly we could go from a situation where we are completely reliant on imports to producing a quarter of our supply domestically. And if there are international troubles, that could be very significant for the well-being of the nation, where we are not scrambling to maintain international trading relationships, but we have built a buffer at home.

Mr. STAUBER. Thank you. I would also like to enter into the record testimony from Mr. Dean Peterson last week, another geologist with decades of experience in the field and in academia, who testified about the importance of the Duluth Complex.

[The information follows:]

TESTIMONY OF DEAN M. PETERSON PH.D., CHIEF GEOLOGIST,
BIG ROCK EXPLORATION
BEFORE THE NATURAL RESOURCES COMMITTEE,
SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
MAY 2, 2023 HEARING ON
"EXAMINING THE MINERAL WEALTH OF NORTHERN MINNESOTA"

Introduction

Mineral deposits are formed as end products of a wide variety of Earth processes and reflect, in essence, a tapestry of time, processes, and geologic terranes. Geologists have long used such knowledge to target exploration programs for specific ore deposit types/commodities within different geologic terranes. Any coherent examination of the vast mineral wealth of Northern Minnesota must begin with an understanding of the geology of the Lake Superior region and how specific profound global geological events in Earth history set the stage for the unique set of world-class mineral resources found therein.

My 35+ years as an economic geologist have primarily been spent out in the field unraveling the geology and mineral potential of the Precambrian rocks of Northern Minnesota. My Ph.D. from the University of Minnesota focused on the gold and copper-zinc mineral potential of a large area of Archean granite-greenstone terrane north of the Mesabi Range. I have worked extensively as an academic researcher and as the Senior Vice President of Exploration for Duluth Metals on understanding the geology and Cu-Ni-Co-PGE mineralization of contact-type deposits of the Duluth Complex. My two seasons of field research on seemingly 100% exposure of mafic intrusions in the McMurdo Dry Valleys of Antarctica, that are similar to the intrusions in the Duluth Complex, has led to a profound new understanding of how these mineral systems work and form world-class ore deposits of critically important minerals. I have recently been a Ph.D. committee member for a University of Michigan student studying the origin of the Ti-Fe-V ores of the Longnose and TiTac deposits along the western margin of the Duluth Complex. I have completed academic research studies on the eastern-most Mesabi Range, defining coherent zones of iron ores at Dunka Pit that perhaps one day could be mined to make DRI-grade (very-low silica) taconite pellets, and am currently actively engaged at Big Rock Exploration in a drilling program for manganese resources within the Emily Deposit of the Cuyuna Range.

It is these unique rocks and their known and potential mineral wealth that is the focus of today's hearing, and I am happy to share my knowledge to the committee. This written testimony will attempt, in general terms, to explain how Northern Minnesota's known mineral resources, including Fe-Mn deposits within the states iron ranges and copper-nickel-cobalt-platinum group element (Cu-Ni-Co-PGE) & titanium-iron-vanadium (Ti-Fe-V) deposits in the Duluth Complex, are the outcomes of specific geological events unique to the Lake Superior region.

Geology of Northern Minnesota

Minnesota is situated at the southern edge of the Canadian Shield, the nucleus of the North American continent that formed during Precambrian time. This period of time encompasses about 85% of Earth's history, beginning with the formation of planet Earth about 4.550 billion years (Ga) ago and ending about 0.54 Ga, when organisms with hard parts, such as shells, rapidly diversified. The great span of Precambrian time is divided for convenience into two major parts—the Archean Eon (4.55–2.50 Ga) and the Proterozoic Eon (2.50–0.54 Ga). The rocks formed in Minnesota during this enormous span of time record a complicated geologic history that involved volcanoes, ocean islands, mountain chains, earthquakes, and eons of time where the landscape simply weathered and eroded away.

As the various mountainous Precambrian landscapes of Minnesota were slowly eroded to low relief over 2.7 billion years, Precambrian rocks that were once much deeper within the Earth are now exposed on the surface in Minnesota's flat terrain. These rocks record processes and conditions that existed beneath landscapes long since removed by erosion. Presently, the deeply eroded Precambrian rocks of Northern Minnesota are mostly covered by a veneer of glacially deposited clay, silt, sand, and gravel.

Archean 2.7 Ga Rocks of Northern Minnesota

The Archean rocks of Minnesota are part of the Superior Province of the Canadian Shield. The Superior Province is subdivided into subprovinces, which are broadly east-west, linear belts of rocks of similar geologic history and age. The sub-

provinces in Minnesota from south to north include the Minnesota River Valley, Abitibi-Wawa, Quetico, and Wabigoon.

The ~2.7 Ga Archean rocks of Northern Minnesota occur mainly north of the Mesabi iron range, and may be seen in Voyageurs National Park, in the western part of the Boundary Waters Canoe Area Wilderness, and in scattered areas elsewhere between International Falls and Ely. This group includes the Abitibi-Wawa granite-greenstone subprovince, the Quetico subprovince, and the Wabigoon granite-greenstone subprovince. The Abitibi-Wawa and Wabigoon subprovinces originally were parts of volcanic chains that were later deformed and intruded by granite. The Quetico subprovince was likely a large sedimentary basin on or between the volcanic arcs of the Wabigoon and Abitibi-Wawa. The granites welded the greenstone belts together to form the core of the North American continent. The end of the Archean Eon is a profound time in Earth history. The formation of stable cratonic cores of continents allowed for the deposition of vast sequences of sedimentary rocks. World-wide, Archean greenstone terranes are known to host some of the largest mineral deposits on Earth, especially iron, orogenic gold, and copper-zinc-rich volcanogenic massive sulfide deposits.

Paleoproterozoic 1.9–1.7 Ga Rocks of Northern Minnesota

One of the most profound events in Earth's history is recorded in the Paleoproterozoic rocks of Northern Minnesota. That event was the proliferation of cyanobacterial life on Earth in shallow water oceanic settings at the margins of eroded Archean cratons. This ancient life, which is recorded in the rocks as fossil stromatolites, released oxygen into the Earth's oceans and atmosphere and thus precipitated vast quantities of dissolved iron out of the ocean to form the chemical sedimentary rocks we call iron formation. Paleoproterozoic rocks occur in Minnesota from St. Cloud northeast to Moose Lake and Carlton, and north up to the Mesabi Iron Range near Eveleth and Hibbing. The southern part of the Paleoproterozoic terrane, approximately south of a line that runs west from Jay Cooke State Park, is a mixture of metamorphosed sedimentary and volcanic rocks and includes the Fe-Mn ore deposits of the Cuyuna iron range. To the south, these rocks were intruded later by several large granitic intrusions, emplaced between 1.80 and 1.76 Ga, that collectively form an amalgamation referred to as the East-Central Minnesota batholith.

The northern part of this terrane is made up of slate and graywacke, iron formation, and quartzite. The base of this sequence is quartzite, formerly sandstone, that was deposited on top of the older Archean bedrock. Above the quartzite is the Biwabik Iron Formation, long mined for its vast quantities of iron ore. Slate and graywacke overly the iron formation and covers a vast area from the Mesabi Iron Range south to Jay Cooke State Park, where one can easily see that it has been folded and deformed.

The metamorphosed volcanic and sedimentary rocks that make up the southern part of the Paleoproterozoic terrane are likely part of a former mountain belt, the Penokean orogen, that extended west from Lake Huron to South Dakota, and perhaps farther, from about 2.0 to 1.8 Ga ago. The eroded remnants of this belt have geologic similarities to modern mountain belts along the west coast of North America. Therefore, geologists infer that mountainous terranes comparable to those currently found in western California existed long ago in Minnesota. During this mountain forming orogenic event, the crust was uplifted, and a large basin formed to the north; sediment shed into this northern segment produced the thick sequence of slate and graywacke in the deeper parts, and along the northern margin of this basin, the Pokegama Quartzite and Biwabik Iron Formation were deposited forming the Mesabi Iron Range, one of the largest mining districts in the world. In 2019, the Paleoproterozoic age iron deposits of the Lake Superior region (Northern Minnesota and Michigan) accounted for 98% of the usable iron-ore products in the United States.

Mesoproterozoic 1.1 Ga Rocks of Northern Minnesota

Mesoproterozoic rocks of Northern Minnesota occur along the shore of Lake Superior, continue south along the Minnesota-Wisconsin border, and extend southwest into Kansas. These rocks formed around 1.1 Ga ago along the Midcontinent Rift system, a major feature that formed by the spreading apart of older continental crust. As the crust spread and thinned, fractures and faults formed, providing pathways for molten magma from the mantle to work its way to the surface, where it erupted as volcanoes. The base of the volcanic pile was intruded by magma that cooled more slowly below the surface, forming troctolite, gabbro, anorthosite, and granite. The wholesale partial melting of the Earth's mantle, and transfer of these magmas upwards into the Earth's crust, is the reason why Northern Minnesota

hosts enormous quantities of critical minerals associated with the Mid-Continent Rift. Essentially every atom of copper, nickel, cobalt, platinum, palladium, gold, silver, titanium, vanadium, and iron known to exist in Mesoproterozoic age ore deposits of Northern Minnesota were transferred by buoyant magmas from the Earth's mantle to crust by these magmas. When volcanism ceased, blankets of sand, now sandstone, were deposited in a basin on top of the volcanic rocks, such as the Hinckley Sandstone exposed in Banning State Park.

Rocks similar to the Mesoproterozoic volcanic rocks exposed along the north shore of Lake Superior were mined extensively for copper in Michigan, but no similar deposits of economic scale have been found here. In Minnesota, an enormous reserve of copper, nickel, cobalt and associated platinum, palladium, and gold exists at the base of the Duluth Complex, along the northwest edge of the Mesoproterozoic system, and in an intrusion near the town of Tamarack. The sandstones that overlie the volcanic rocks have been quarried in the past for building and paving stone, and gabbro and anorthosite is quarried for both dimension stone and road aggregates.

Mineral Resources of Northern Minnesota

Since the 1880s, two broad types of mineral resources have been actively mined and/or explored for in northern Minnesota. They are: 1) ***Ferrous resources***, which include iron (Fe) deposits of the Archean 2.7 (Ga) Vermilion Range, the Paleoproterozoic 1.85 Ga Fe deposits of the Mesabi Range, and manganese-iron (Mn-Fe) deposits of the Cuyuna Range; and 2) ***Non-ferrous resources***, which include the Mesoproterozoic (1.1 Ga) Cu-Ni-Co-PGE and Ti-V deposits of the Mid-Continent Rift. Also, numerous mineral exploration programs in the Archean 2.7 Ga greenstone belts of Minnesota over the last 60 years have identified numerous prospective lode-gold and copper-zinc target areas. This written testimony includes as a supporting document a bedrock geology and mineral resource map of Minnesota that highlights the 8th Congressional District (Peterson, 2022).

Ferrous Resources

The ferrous mineral resources of Northern Minnesota include several categories of marine chemocline mineral systems outlined in recent USGS publications (Schulz et al., 2017 and Hofstra and Kreiner, 2020). These categories include: 1) Superior-type iron deposits (Mesabi Range), 2) Iron-Manganese deposits (Cuyuna Range, 100 million tons), and 3) Algoma-type iron deposits (Vermilion Range (102 million tons). Brief descriptions of the geology and mineral resources of the Mesabi and Cuyuna iron ranges is provided below.

Superior Type Iron Resources of the Mesabi Iron Range

Superior type iron formation resources of Minnesota are exemplified by the long-standing mining of iron resources of the Biwabik Iron Formation along the length of the Mesabi Iron Range. The Mesabi Iron Range is largely located in St. Louis and Itasca counties and has been the most important iron ore district in the United States since ~1900. The Mesabi Iron Range is 120 miles long, averages one to two miles wide, and is comprised of rocks of the Paleoproterozoic Animikie Group. The Animikie Group on the Mesabi Iron consists of three conformable major formations: Pokegama Formation at the base; Biwabik Iron Formation in the middle; and the overlying Virginia Formation. On the Mesabi Iron Range, these three formations display gentle dips to the southeast at an angle of 3–15 degrees.

Leached and iron enriched direct ores (or natural ores) were the first materials mined from strongly oxidized pockets along fault and fracture zones and the blanket oxidation at the surface in the iron formation (Marsden et al., 1968), with the first shipment beginning in 1892. Taconite, which is the material that is mined today using magnetic separation methods, constitutes most of the iron formation and pertains to the hard, non-oxidized portions of the iron-formation. Maps of currently active taconite mining operations and the historic natural ore mines on the Mesabi Iron Range are presented on inset maps 1, 2, and 3 on the provided bedrock geology and mineral resources map (Peterson, 2022). Compiled grade/tonnage ore reserve calculations for the active taconite operations on the Mesabi iron range are given in Table 1.

Table 1. Recent grade-tonnage reserve estimates of the Mesabi Iron Range taconite mines.

Mine	~ Year	Category	Tonnes	*Fe %
Northshore	2019	Proven & Probable	829,096,800	24.3
United Taconite	2019	Proven & Probable	817,920,250	22.3
Hibbing Taconite	2019	Proven & Probable	123,856,495	19.7
Minorca	2018	Proven & Probable	101,000,000	23.5
Minntac	2019	Proven & Probable	420,644,700	?
Keetac	2019	Proven & Probable	373,906,400	?

** Reported as recoverable magnetic Fe %*

~ Data compiled from company annual reports

Total Tonnes: 2,666,424,645

Mn-Fe Resources of the Cuyuna Iron Range

The Cuyuna Range is about 160 km west-southwest of Duluth in Aitkin, Cass, Crow Wing, and Morrison Counties, and is part of a Paleoproterozoic (1.9–1.8 Ga) geologic terrane which occupies much of east-central Minnesota. Since their discovery in 1904, it has been recognized that the iron-formations and associated ore deposits of the Cuyuna Range contained appreciable quantities of manganese which was extracted as ferromanganese ores from several mines on the North range from 1911 to 1984. The presence of this manganese resource sets the Cuyuna range apart from other iron-mining districts of the Lake Superior region.

The Cuyuna iron range is traditionally divided into three districts, the Emily district, the North range, and the South range. The Emily district extends from the Mississippi River northward through Crow Wing County and into southern Cass County. Although exploration drilling has been extensive in the Emily district, mining never commenced. The North range, located near the cities of Crosby and Ironton in Crow Wing County, was the principal site of mining activity (ceased in 1984) of the Cuyuna. The South range, where only a few mines were operated in the 1910s and 20s, comprises an area of northeast-trending, generally parallel belts of iron-formation extending from near Randall in Morrison County northeast for about 100 km. In addition to the three named districts, numerous linear magnetic anomalies occur east of the range proper, and may indicate other, but as yet poorly defined, beds of iron-formation.

Several attempts have been made over the last 70 years to estimate the size of the manganese resources of the Cuyuna iron range. For example, Lewis (1951) estimated that 455 million metric tons of manganiferous iron-formation containing from 2 to 10 percent manganese were available to open-pit mining to a depth of 45 meters. Dorr et al., (1973) used that estimate to establish that the Cuyuna range contains approximately 46 percent of known manganese resources in the United States. US Steel geologist Richard Strong (1959) estimated iron and manganese resources from several well-drilled deposits in the Emily District and Beltrame et al., (1981) estimated a minimum of 170 million metric tons of manganiferous rock with an average grade of 10.46 weight percent manganese. All of these historic grade/tonnage estimates should be considered with a certain amount of skepticism as they do not conform to current best practices of mineral resource estimation. A listing of the grade and tonnage from properties that Strong (1959) and Beltrami et al., (1981) estimated manganese resources is given in Table 2.

Table 2. Historic grade-tonnage estimates (non-NI 43-101 compliant) of manganese resource within the Cuyuna Iron Range. Table only lists those properties with estimated >500,000 tons of ore.

Property	Area	Year	Tons	Mn %	Mn lbs
West Ruth Lake Deposit	Emily District	*1959	24,012,200	15.28	8,088,891,898
Lake Mary Deposit	Emily District	*1959	8,536,562	8.30	1,561,700,137
East Ruth Lake Deposit	Emily District	*1959	4,874,300	7.65	821,956,313
Emily-Shawnut Reserve	Emily District	~1981	833,709	10.56	194,006,830
Zeno Reserve	North Range	~1981	1,284,211	12.81	362,676,390
Pontiac Mine	North Range	~1981	883,351	16.81	327,418,704
Gloria Mine	North Range	~1981	559,711	12.59	155,354,314
Sagamore Mine	North Range	~1981	641,491	8.79	124,279,088
Huntington Mine	North Range	~1981	866,032	3.59	68,479,191
Omaha Mine	South Range	~1981	1,507,189	3.14	104,335,269
Clearwater Lake Reserve	South Range	~1981	581,549	3.61	46,234,409

** Estimate from Strong, 1959*
~ Estimte from Beltrame et al., 1981

Total Mn (lbs): 11,855,332,543

Non-ferrous Resources

The non-ferrous mineral resources of Northern Minnesota include several categories of mafic magmatic mineral systems outlined in recent U.S. Geological Survey publications (Schulz et al., 2017 and Hofstra and Kreiner, 2020). These categories include: 1) Contact-type Cu-Ni-Co-PGE sulfide deposits; 2) Conduit-type Ni-Cu-Co-PGE sulfide deposits: and 3) Iron-Titanium oxide (Fe-Ti-V-P) deposits. All of these non-ferrous mineral resources are related to the 1.1 Ga Mid-Continent Rift. A summation of published values of known in-situ contents of base metals (Cu-Ni-Co) and precious metals (Pt-Pd-Au-Ag) for the contact-type and conduit-type mineral resources of Northern Minnesota is given in Table 3.

Table 3. In-Situ value estimate of the known mineral deposits of the Mid-Continent Rift in the State of Minnesota.

Metal Contents		Current Metal Prices		
Metal	lb/oz	Price	Unit	*Value
Copper	85,627,994,908	$3.88	pound	$332,236,700,000
Nickel	26,279,521,449	$10.83	pound	$284,607,000,000
Cobalt	2,107,878,394	$15.84	pound	$33,389,000,000
Platinum	26,331,801	$1,074	troy ounce	$28,280,000,000
Palladium	66,140,009	$1,430	troy ounce	$94,580,000,000
Gold	14,453,135	$1,988	troy ounce	$28,733,000,000
Silver	419,059,542	$25.01	troy ounce	$10,703,000,000

* Value rounded to the nearest million dollar
Data from NI 43-101 & related documents
April 28, 2023 metal prices

TOTAL: $812,528,700,000

Contact-type Cu-Ni-Co-PGE sulfide deposits

Contact-type Cu-Ni-PGE magmatic sulfide deposits (Zientek, 2012) of the midcontinent of North America are exemplified by the large, mainly disseminated sulfide deposits that occur along the basal contact of the Duluth Complex where magmas intruded and incorporated footwall Paleoproterozoic Animikie Group metasedimentary rocks and Archean granitoids. Major deposits include Birch Lake, Maturi, Mesaba, NorthMet, Serpentine, and Spruce Road. Disseminated and local massive sulfide mineralization of the Duluth Complex was historically estimated to

contain about 4.4 billion metric tons of ore with average grades of 0.66% Cu and 0.2% Ni at a 0.5% Cu cut-off (Listerud and Meinike, 1977). Recent exploration and project development for many of these Duluth Complex contact-type deposits has led to upgraded mineral resource estimates for many of these deposits via the publication of numerous Ni 43-101 compliant mineral resource estimates. Combined together the upgraded estimate contains 9.57 billion metric tons with average grades of 0.406% Cu, 0.126% Ni, and 0.326 g/t Pt-Pd-Au.

Conduit-type Ni-Cu-Co-PGE sulfide deposits

Conduit-type Ni-Cu-PGE sulfide deposits are defined as magmatic sulfide mineralization restricted to small- to medium-sized mafic and/or ultramafic tube-like intrusions or dikes that served as pathways for flow-through of picritic and/or Mg-rich basaltic magmas (Schulz et al., 2014). These important sulfide deposits are unique in that they typically contain more metal and sulfur than could be derived from a magma volume equal to the limited volume of the small intrusions that host deposits. This implies that these deposits were products of a greater volume of magma than the current volume of the host intrusion. Thus, conduit-type sulfide deposits are the product of a large volume of magma that moved through open conduit systems, enriching an immiscible sulfide liquid with metals such as Ni, Cu, Co, and PGE. Rocks that make up host intrusions generally do not represent primary magmas, but are accumulations of olivine, pyroxene, and immiscible sulfide liquid.

The Tamarack deposit is the only documented conduit-type sulfide deposit in Northern Minnesota. The ultramafic Tamarack Intrusive, with a minimum intrusion age of 1105.6±1.2 Ma (Goldner, 2011), is made up of several distinct intrusive bodies, including an ovoid-shaped Bowl Intrusion of oxide gabbro and two sulfide mineralized intrusive dike-like peridotite bodies that give the complex a tadpole shape (Taranovic et al., 2015). Mineralization at Tamarack consists of disseminated to net textured to massive pyrrhotite, pentlandite, chalcopyrite, and minor cubanite.

Ti-Fe-V Resources of the Duluth Complex

Small titanium-iron±vanadium oxide-rich, plug-like, discordant intrusions along the southern basal section of the Duluth Complex are called Oxide-Ultramafic Intrusions, or OUIs. Rock types carrying the Ti-Fe±V oxide mineralization in OUIs include dunite, peridotite, and pyroxenite, typically with more than 10% semi-massive to massive oxide zones (Severson and Hauck, 1990). Deposits, including the major OUIs Longnose, TiTac, and Water Hen, can also carry minor Cu sulfide mineralization.

Identified resources of Minnesota's OUI associated Ti-Fe-V deposits include the: 1) Longnose deposit, with a NI 43-101 indicated resource of 58.1 million tons averaging 16.6% TiO_2 (inferred 65.3 million tons averaging 16.4% TiO_2) based on 27 drill holes and using a cut-off grade of 8% TiO_2; 2) Titac deposit, with a NI 43-101 inferred resource of 45.1 million tons averaging 14% TiO_2 based on 32 drill holes and using a cut-off grade of 8% TiO_2; and 3) Water Hen deposit, with a crudely estimated 62 million tons averaging 14% TiO_2 and significant graphite resources, based on 37 drill holes.

Summary

Ore deposits represent the preferential concentration of specific elements within the earth via the transfer of mass and energy over space and time. The bedrock geology within the state of Minnesota represents a mosaic of geological terranes that facilitated ore-forming processes unique to this region and underpins a remarkable endowment of mineral resource wealth within the United States. The geology and mineral deposits of the Lake Superior area in general, and Northern Minnesota in particular, are unique. No other area of the United States of America hosts such an array of Precambrian rocks and the world-class ore deposits that these rocks contain. As the fifth most valuable state with respect to mineral production (USGS, 2022), Minnesota stands alone in its potential to advance the domestic supply of many critical minerals into the United States economy and lead the way toward a brighter future.

References

Beltrame, R.J., Holtzman, R.C., and Wahl, T.E., 1981, Manganese resources of the Cuyuna range, east-central Minnesota: Minnesota Geological Survey Report of Investigations 24, 22 p.

Dorr, J.VN., II, Crittenden, M.D., Jr., and Worl, RG., 1973, Manganese, in Probst, D.A., and Pratt, W.P., eds., United States Mineral Resources: U.S. Geological Survey Professional Paper 820, p. 385–399.

Goldner, B.D., 2011. Igneous petrology of the Ni-Cu-PGE mineralized Tamarack Intrusion, Aitkin and Carlton Counties. Unpublished M.S. thesis, Univ. Minn.-Duluth, Duluth, MN, pp. 155.

Hofstra, A.H., and Kreiner, D.C., Systems-Deposits-Commodities-Critical Minerals Table for the Earth Mapping Resource Initiative: U.S. Geological Survey Open-File Report 2020–1042, 24 p.

Lewis, W.E., 1951, Relationship of the Cuyuna manganiferous resources to others in the United States, in Geology of the Cuyuna range-Mining Geology Symposium, 3rd, Hibbing, Minnesota, Proceedings: Minneapolis, University of Minnesota, Center for Continuation Study, p. 30–43.

Listerud, W.H., Meineke, D.G., 1977. Mineral resources of a portion of the Duluth Complex and adjacent rocks in St. Louis and Lake Counties, northeastern Minnesota. Minn. Dept. Nat. Res. Div. Min. Rep. 93, pp. 74.

Marsden, R.W., Emanuelson, J.W., Owens, J.S., et al., 1968, The Mesabi Iron Range, Minnesota, in Ridge, J.D. (ed.), Ore Deposits of the United States, 1933–1967: New York, American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., The Grafton-Sales Volume, v. 1, p. 518–537.

Peterson, D.M., 2022, Precambrian bedrock geology and mineral resources map of Minnesota: Highlighting the 8th Congressional District of the U.S. House of Representatives, Big Rock Exploration map BRE-Map-2022-01

Schulz, K.J., DeYoung, J.H., Jr., Seal, R.R., II, and Bradley, D.C., eds., 2017, Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply: U.S. Geological Survey Professional Paper 1802, 797 p., https://doi.org/10.3133/pp1802.

Schulz, K.J., Woodruff, L.G., Nicholson, S.W., et al., 2014, Occurrence model for magmatic sulfide-rich nickel-copper-(platinum-group-element) related to mafic and ultramafic dike-sill complexes. U.S. Geol. Surv. SIR 2010-5070-I, pp. 80.

Severson, M.J., Hauck, S.A., 1990. Geology, geochemistry, and stratigraphy of a portion of the Partridge River intrusion. Nat. Res. Resch. Inst. NRRI/TR-59/11, pp. 149.

Strong, R., 1959, Report on Geological Investigation of the Cuyuna District, Minnesota, 1949–1959, US Steel Internal Report, 318 pages.

Taranovic, V., Ripley, E.M., Li, C., Rossell, D., 2015. Petrogenesis of the NI-Cu-PGE sulfide-bearing Tamarack Intrusive Complex, Midcontinent Rift System, Minnesota. Lithos, 212–215, 16–31.

U.S. Geological Survey, 2022, Mineral commodity summaries 2022: U.S. Geological Survey, 202 p., https://doi.org/10.3133/mcs2022.

Zientek, M.L. 2012. Magmatic ore deposits in layered intrusions—Descriptive model for reef-type PGE and contact type Cu-Ni-PGE deposits. U.S. Geological Survey OFR 2012-1010, 48 pp.

Mr. STAUBER. Mr. Chura, thank you again to you and Jobs for Minnesotans for the important work you do.

Wages for the mining sector in Minnesota far outpace the average in the state by about 25,000. In your experience as Chairman, can you compare the benefits of high-wage, year-round mining jobs and seasonal tourism jobs?

Mr. CHURA. Thank you, Mr. Chairman. Yes, tourism is an important part of our culture in northern Minnesota, but most of those jobs are seasonal jobs compared to the jobs that mining would provide, which are family-sustaining jobs.

If you look at the average wage in the tourism industry, it is around $23,000 annually. Compare that to the average wage of a mining job, which is around $98,000 annually. That is a 123 percent increase in the average wage for the region when you look at a mining wage compared to other job opportunities.

In addition, the benefits are significant. A friend of mine who is a miner who went through a battle with cancer, she put it to me this way. She said, "The difference between the benefits that I had working for a mine and others, I didn't have to put together a GoFundMe site."

One job within the mining industry creates about two spin-off jobs as well, which further benefit our communities. So, these jobs are important, and they are significant.

Mr. STAUBER. Thank you for your testimony. I have run out of time. I now turn it over to the Ranking Member for her 5 minutes of questioning.

Ms. OCASIO-CORTEZ. Thank you, Mr. Chair.

Senator Bakk, I was hoping you could help me clarify something. I see here that you are testifying today as a former State Senator, but we have seen some materials here that suggest you may be a registered lobbyist within the state of Minnesota to lobby on behalf of Twin Metals Minnesota. Is that correct?

Mr. BAKK. Thank you for the question. I retired after almost 30 years in the State Legislature on——

Ms. OCASIO-CORTEZ. Are you presently a registered lobbyist in the state of Minnesota for Twin Metals Minnesota?

Mr. BAKK. Let me explain it to you.

Ms. OCASIO-CORTEZ. Is it yes or no?

Mr. BAKK. I am going to give you a yes or no.

Ms. OCASIO-CORTEZ. Is it——

Mr. BAKK. I retired on January 3 and opened and started a consulting business, an LLC. I have a number of clients. Some of them require registration with the Minnesota Campaign Finance Board.

Ms. OCASIO-CORTEZ. And is Twin Metals Minnesota one of those clients?

Mr. BAKK. Twin Metals is one of them, and I did disclose that.

Ms. OCASIO-CORTEZ. OK, was that disclosed with the state? I failed to see it in your opening statement, I failed to see it in the statement you just delivered here.

And, to clarify, Twin Metals Minnesota, it is that company's leases that were canceled by the Biden administration that are partially subject to the matters of this hearing today.

But I want to thank you. I think it is important for us to have clarity. I am not sure why that detail was excluded. I think it is highly relevant present experience that should be disclosed.

Mr. STAUBER. Ranking Member Ocasio-Cortez, it was disclosed in his written testimony.

Ms. OCASIO-CORTEZ. In his written testimony, but not the opening statement.

Mr. STAUBER. And it is required that he did disclose that.

Ms. OCASIO-CORTEZ. And did, OK. But I would like to note it was not included in the opening statement.

And Mr. Chura, you are employed by Minnesota Power, an ALLETE company, correct?

Mr. CHURA. That is correct. But I am here today representing Jobs for Minnesotans.

Ms. OCASIO-CORTEZ. And Minnesota Power supplies electricity in northeastern Minnesota. Mines in northeastern Minnesota are one of the largest customers of Minnesota Power, correct?

Mr. CHURA. Correct.

Ms. OCASIO-CORTEZ. I would like to submit to the record here an article from the *Star Tribune* citing that 74 percent of Minnesota Power's energy does not go to Minnesotans. It goes to the taconite mines and paper mills. So, these mines are one of the largest customers of Minnesota Power.

I also want to reiterate what we have heard here today. We have two witnesses that have present connections, not past, in stakeholders with a financial interest in advocating for large new mines in the state, regardless of whether or not it would result in economic benefits. I think this is important, and relevant connections that should be clearly communicated.

Ms. Rom, we have heard plenty on that so far, but I want to talk a little bit about the harms that this project would actually cause to the ecosystem and the people who live in the Boundary Waters area. You have shared that nearly 70 percent of Minnesotans support a permanent ban on sulfide ore copper mining in the Boundary Waters and headwaters. How have industry lobbying like what we have heard today distorted some of the on-the-ground communities' perspective?

Ms. ROM. Thank you, Ms. Ocasio-Cortez, for your question.

I am here as a volunteer. For the last 10 years, constituents of Minnesota, oftentimes the 8th Congressional District, and also Americans from across the country have been coming to Washington, DC to plead our case as volunteers, as people who love the Boundary Waters, who work in the Boundary Waters, have businesses there.

Antofagasta last year spent over $1 million on lobbyists to lobby in Washington, DC in opposition to the volunteers like me that you are seeing here. And that doesn't count Mr. Bakk, who is a Minnesota lobbyist. So, there has been a significant financial unevenness, if you will, with the American people against this giant billionaire mining company. The——

Ms. OCASIO-CORTEZ. I apologize, and feel free to continue your sentence, but I would also like to hear if you could speak more to the science that leads us to believe that this project would be harmful to the ecosystem, as well.

Ms. ROM. Thank you. The science is overwhelming. It has been peer reviewed, it has been published. It demonstrates that a sulfide ore copper mine in the location of the Twin Metals mine would pollute the Boundary Waters. It is not a matter of if; it is a matter of when.

The EPA has said this is acid-generating ore. Twin Metals never was able to prove that was otherwise. And most recently, the state of Minnesota said to Twin Metals, "You can't put your tailings waste facility on our land because that will expose us to potential Superfund liability."

So, it is the consensus of the scientific community that this would pollute, damage, and destroy the Boundary Waters.

Ms. OCASIO-CORTEZ. Thank you. I yield back.

Mr. STAUBER. Thank you. The Chair now recognizes Representative Fulcher for 5 minutes.

Mr. FULCHER. Thank you, Mr. Chairman, and thank the panel for being here, and for your comments and input.

We are here today to talk about H.C. Res. 34, disapproving the Administration's disapproval of 225,000 acres-plus National Forest System lands from disposition under the United States mineral and geothermal leasing laws.

And 225,000-plus acres, I think it is worth putting that in perspective. If I have done my math right—and I did it pretty quickly, but I think it is right—that is 12.3 times larger than the New York Congressional District 14, Ranking Member's district, 12.32 times. That is a fair amount of space.

And the problem is it is not just in Minnesota, it is all over the country, including my home state of Idaho. We have a cobalt mine we have been trying to get permitted for 30-plus years, 30-plus years. How in the world these organizations can finance for that long, when you never know if and when you are going to get a permit, is beyond me.

And here is what that has led to. Mr. Chairman, I think there is a chart if we can put it on the screen, a year 2022-dated net import reliance chart.

[Chart.]

Mr. FULCHER. If you would, please take a look at that. This is from the U.S. Geological Survey, and for me, a picture is worth a thousand words. It tells you just how reliant the United States has become on other nations when those resources are under our feet.

Here are some statistics. According to this backup info on this chart, the U.S. Geological Survey, 2023 Minerals Commodity Summaries Report: "The U.S. reached a record high for U.S. mineral imports, marking an all-time low for supply chain stability." According to the report, the U.S. is more than 50 percent reliant on 51 minerals, up from 47 the prior year. The U.S. is 100 percent net import reliant on 15 of those 51 minerals.

Mr. FULCHER. And I think I have a chart behind me on copper, which will kind of tell the story on that.

[Chart.]

Mr. FULCHER. According to Benchmark Mineral Intelligence, they estimate that more than 300 new mines need to be built just to meet the electronic vehicle demand of the people who are opposing the mining in this country.

I mean, you can't make this stuff up. I love you guys on the other side of the aisle, but you cannot think when it comes to this type of thing. You are locking us into demand outside this country. But yet you want electronic vehicles.

Ms. Rom, have you ever been to China?

Ms. ROM. No.

Mr. FULCHER. Have you ever seen a mine in China?

Ms. ROM. No, but I do know that the metal concentration from Twin Metals will go to China——

Mr. FULCHER. I used to do business there, quite a bit of it. I used to do business there personally. I have seen them. Believe me, if you don't like it in Minnesota, you really won't like it in China. And they happen to live on the same planet you and I do. But with these policies, and by just locking things down, that chart is what you get.

Ms. ROM. May I respond?

Mr. FULCHER. No, you can't. Not now. I will relax in a minute here. Well, no, I won't relax. I will turn it over in a minute.

Ms. ROM. May I respond, sir?

Mr. FULCHER. This is what you get when you take this not-in-my-backyard argument. And not only that, but we are much, much, much more responsible than China.

So, on the one side, my friends say we want to lock it down, we want more electronic vehicles, we want to have green this, green that, but not to support the industry here. Same thing with windmills, same thing with solar panels, by the way. Let's go get it from someplace else. Let's use child labor and do it irresponsibly in China. OK. Makes a lot of sense. But that is your argument.

Mr. Chairman, it is time that we respect not only the needs of our nation and the reliability of that, but it is time that we do so responsibly, and we also are responsible with the environment. That is the point. We are the environmentalists. We are the one who is doing it responsible. These minerals are going to come from some place. Why not do it responsibly?

Ms. Rom, you had something to say.

Ms. ROM. Thank you.

Mr. FULCHER. You have 15 seconds.

Ms. ROM. Thank you.

First of all, we are not anti-mining, but we aren't so poor that we can't save the most special places in America.

Mr. FULCHER. Oh, OK. Take a look at that chart. I am reclaiming my time. Take a look at the chart, and you tell me that you are not anti-mining in those interests that you represent.

Mr. Chairman, I yield back.

Mr. STAUBER. Thank you very much. The next questioner will be Mr. Huffman from California.

Mr. HUFFMAN. Thank you, Mr. Chairman.

And, Mr. Foucher, we love you, too.

Mr. FULCHER. Fulcher.

Mr. HUFFMAN. Fulcher. I knew that, too.

We have a misinformation problem here in this Committee. We don't talk about the places where we actually can sustainably mine. We don't talk about the opportunities to get a lot of this material from recycling, which is going to create great jobs. We don't talk about the Salton Sea, which may not be exactly in my backyard, but it is kind of close, and I am saying yes. And I want you to come and see how huge amounts of lithium and manganese are going to be drawn out of the brine that we are going to use for geothermal energy, and it is going to be great for jobs, and for electrifying the transportation sector and for the Salton Sea region. We don't talk about any of that.

What we do talk a lot about are really special, wild places that are worth protecting in this country, that are undeniably unique and beautiful, but are threatened by an extractive industry that the Trump administration has granted access to and the Biden administration, in an open, science-based process, decides need to remain protected. That pattern is playing out over and over in this Subcommittee, unfortunately. And with the Boundary Waters, this is a unique ecological area that needs to be protected.

In this hearing and with some of this legislation, it seems like we are paving new frontiers in gaslighting. We have a bill called the Superior Forest Restoration Act, which has nothing to do with restoring a forest; it is about restoring mining interests in that forest. I mean, give me a break.

We are having a pep rally here for the taconite mining that has historically taken place safely in another part of the state, and we are not even talking about taconite mining in this case. We are talking about a Chilean company that wants to come in and set up shop in the watershed of a river that flows right into the Boundary Waters. And when the Forest Service took a look around the world at the operating sulfide ore copper mines around the world, they found that 100 percent of them have pipeline leaks and other accidental releases of acid mine drainage. Everybody knows this type of mining is different than the taconite mining that everybody has been celebrating here, and it involves a much greater risk of acid mine drainage.

So, we have to stop the gaslighting. There is a lot that we could talk about to find the minerals sustainably that we need to make this important clean energy transition, but we have to stop talking about special places and presenting this false choice.

Now, Ms. Rom, we have mentioned several times that one of the two pieces of legislation we are considering, H. Con. Res. 34, is unconstitutional. And I don't want you to get too wonky about legislative vetoes and all of the arcane reasons, but can you maybe in 30 seconds tell us why it is unconstitutional?

Ms. ROM. Thank you. Well, this is the first time in more than 90 large mineral withdrawals under FLPMA where a Member of Congress has introduced a resolution for a legislative veto, sad to say.

In 1983, the U.S. Supreme Court ruled in the *Chadha* case that legislative vetoes which bypassed the President are unconstitutional. It has never been challenged since then. And in 2017, in a case brought by the National Mining Association arguing that, sure, it was unconstitutional, but you can't sever it from FLPMA, so the whole mineral withdrawal section fails, the Ninth Circuit said no. So, everybody agrees it is unconstitutional.

It is also extremely sad that a resolution has been brought relative to a mineral withdrawal order that protects America's great canoe country wilderness.

Mr. HUFFMAN. Now, the mining industry itself has argued that this very type of legislation is unconstitutional, correct?

Ms. ROM. Yes, it is also in the House Manual.

Mr. HUFFMAN. Right, so this isn't even really a debatable point.

Ms. ROM. No.

Mr. HUFFMAN. This is unconstitutional stuff. And that is one of the bills that we are considering.

Let's go to the type of mining that we are talking about here. This is fundamentally different, what Twin Metals, the Chilean company, is proposing to do in the watershed of the Boundary Waters, correct?

Ms. ROM. Yes. It has less than 1 percent metal content, which means 99 percent is waste. My grandfather, the mining he did, it

was 50 to 70 percent pure iron ore. Taconite is 20 to 30 percent iron ore. This is radically different.

Mr. HUFFMAN. All right. And lastly, we have heard a lot about the economic arguments here, including from some who have personal vested interests in the economics of this mining proposal. But there was a peer-reviewed Harvard study that actually looked at mining withdrawal versus the granting of permits for these mines. They found something over a 20-year period. Are you familiar with their finding?

Ms. ROM. I am. It is the only independent, peer-reviewed study that looked across 20 years and considered costs and benefits, and it said the regional economy would be far better off, both in terms of more income and more jobs, if there was no mining in the watershed of the Boundary Waters.

Mr. HUFFMAN. Thank you very much. I yield back.

Mr. STAUBER. Thank you very much. The Chair now recognizes Mr. Rosendale.

Mr. ROSENDALE. Thank you very much, Mr. Chair and Ranking Member Ocasio-Cortez.

And I really appreciate the fact that you brought up the insinuations about conflicts and self-enrichment about people that are testifying, and how that actually impacts the quality, if you will, of the testimony and what we are trying to do here. I do appreciate that.

So, Mr. Chair, I would like to ask you a question. Do you know if Secretary Haaland produced the information in regards to the Freedom of Information Act requested by the Protect the Public's Trust which pertains to her daughter lobbying employees of the Department of the Interior and Bureau of Land Management, and also participating in a protest at the Department of the Interior, which devolved into a riot?

I questioned her about that at the last hearing. The information was requested back in January, and I don't know if she has ever fulfilled that.

Mr. STAUBER. I can't answer that. I don't have direct knowledge of whether the Committee has received that yet.

Mr. ROSENDALE. OK. We sure would love to know. If we are going to have discussions about conflicts and self-enrichment, that the Secretary of the Interior, you would think that she would want to provide that information to make sure that she at least provided the perception of an unbiased and impartial ability to conduct her job.

Chairman Stauber and Ranking Member Ocasio-Cortez, thank you for holding the hearing today. I believe the ability to mine hardrock minerals resources on American soil is one of the most important tactics that we can use to provide our country with sustainable energy independence as our country moves toward cleaner energy production.

As this Committee is aware, my state, Montana, is one of the most mineral-rich states in our nation, and the withdrawal of mining in this Minnesota territory sets a precedent that will be wide-reaching to many other states, and blocks our transition toward energy independence and further our reliance on China for necessary minerals, as we have seen by these charts. It is of vital

importance that this Committee protect our nation's ability to mine and produce minerals necessary while refusing to acquiesce to political activists who are seeking to prevent our ability to provide our country with a cleaner and more independent future.

This Congress, I have been vocal about the Administration's refusal to adhere to the Mineral Leasing Act's requirement to hold quarterly lease sales, and this action from Interior only further exemplifies this Administration's lack of seriousness in creating a cleaner, more independent energy infrastructure right here in America.

This hearing will provide us with the opportunity to continue our fight against this Administration's arbitrary decision-making, and allow us to gather the information needed to help stimulate the Minnesotan economy and prevent against bad precedent, forbidding other states from mining and obtaining these important minerals. I sincerely hope that this Committee will take this seriously, and continue to fight for and protect the freedoms of Montanans, Minnesotans, and all Americans.

We have several mines that are being tied up right now in Montana because of activist judges for copper, for coal, for the things that we need to provide not only heat, not only energy, but an economy. And as I have discussed in this room many times over, to have low-cost energy has lifted more people out of poverty and terrible conditions where they don't even have fresh water than virtually anything else that we have done. And we have to start unleashing these minerals.

And if you believe, if you believe, Ms. Rom, that mining for minerals in the United States is bad, then you have not been to China, as my colleague from Idaho referenced, because the labor standards and the environmental standards that are being utilized around the world are much, much worse. And if you believed what you are sitting there preaching to us, you would demand that it was taking place here in our country, because we do it with better labor standards and environmental standards than anyone else in the world.

I yield back.

Mr. STAUBER. Thank you very much. And now the Chair recognizes the Ranking Member of the Full Committee, Ranking Member Grijalva.

Mr. GRIJALVA. Thank you, Mr. Chairman and the Ranking Member. I appreciate the time.

I thought, rather than rehashing a settled score, I was hoping we could instead be working together as a Committee to reform the future of mining to make it more sustainable, modern, and predictable: the certainty question that keeps coming up. But I am not only concerned, we have completely different visions about what that future should be.

And our clean energy future should not be an excuse to extend mining industries' control and destruction even further. This is an opportunity to raise the bar for mining across the globe, set the example, demonstrate that some places like the Boundary Waters are simply too special to mine.

And I was hopeful last time around, 2019, that we had reached some common ground when House Republicans championed the

withdrawal on the boundary of the Yellowstone National Park. That provision was signed into law by President Trump as the package that established 1.3 million acres of wilderness and protected Montana's Paradise Valley from a mine that was being proposed because of the opposition and concern of the surrounding communities.

What is good for the goose sometimes has to be good for the gander, as well. And this withdrawal of the Boundary Waters that the Administration has re-implemented is necessary. It is a special place. We continue to have those arguments over and over again.

But the fact remains that we are working with a law, 1872 mining law, that essentially puts control and an inordinate amount of power and decision-making in the hands of the industry and not in the hands of the public and the public interest. And that is the premise. That is the basis. I don't hear from my colleagues across the aisle one peep about doing something about reforming and changing that antiquated law.

And as long as that law maintains where no royalties are paid, I don't care if the company is foreign, like in this case, Chilean, I don't care. They don't pay any royalties. There is no tribal consultation, firm, established, meaningful consultation with tribes ahead of time. There is no protection for special places, and there is no real transparency and no real discussion about what sustainability is in the mining industry and how that should be crafted, because no options are presented other than a yes-or-no proposition on these questions.

So, I am glad the Biden administration withdrew it. I am glad they are following the science. I am glad they are following the process in the Boundary Waters.

I also think that as this discussion continues, that we lowered the bar in these discussions. And as long as this law is in place, these discussions are going to continue to be one of fact and science versus the power and the influence under the 1872 law that industry and the mining industry in particular have over public interest and public policy.

I would like to ask all four of you for a yes-or-no answer. The 1872 Mining Law, its function, do you believe that it should be reformed in the kind of parameters that I have discussed earlier?

I would just go down the aisle, if you don't mind, starting with you, Mr. Senator.

Mr. BAKK. Well, I am not familiar with it, but if it should be reformed, there should be a bill introduced, and it should go through the regular Committee process, through the Congress.

Mr. GRIJALVA. And we should probably have a hearing like we are having a hearing here today. Those bills have been introduced time and time again. And I think, given the discussion around mining, that it is time we had that hearing.

Sir?

Dr. THORLEIFSON. Thank you for the opportunity. My job is science to inform all involved, so I would hope to be active in supporting any deliberations on that matter.

Ms. ROM. I strongly support modernizing and reforming the 1872 Hardrock Mining Act.

Mr. GRIJALVA. Sir?

Mr. CHURA. I welcome a discussion on mining. I welcome a discussion on giving projects the opportunity to go through a process to show that they can operate safely and responsibly.

Mr. GRIJALVA. So, you would support reform to the 1872 mining law?

Mr. CHURA. I would support a discussion on the regulations in place.

Mr. GRIJALVA. OK. I had questions. I have something for the record, Mr. Chairman, an opening statement.

With that, let me yield back, and I appreciate the time.

Mr. STAUBER. Without objection, you can enter your opening statement.

[The prepared statement of Mr. Grijalva follows:]

PREPARED STATEMENT OF THE HON. RAÚL M. GRIJALVA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ARIZONA

Thank you, Mr. Chairman and Ranking Member Ocasio-Cortez. And thank you to our witnesses for taking time out of your busy schedules to travel here today.

Many of us here are very familiar with the fight over mining in the Boundary Waters watershed.

We've been having hearings on this issue going back years. At this point, it should be settled, as the Ranking Member already stated.

That's because the Biden administration—unlike the previous administration—took the time and effort do the process right and landed on the decision to protect the Boundary Waters region from mining for the next 20 years.

The decision was based on sound science, community input, robust tribal consultation, and, at the end of the day, the best interests of the American people.

But Republicans don't like it. As they've made pretty clear this congress, their priority isn't science or protecting communities—their priority is putting the polluting industry above all, and using any means necessary to do so.

That includes holding our entire economy hostage unless we pass their ransom note of extreme demands, including a long list of polluters over people policies.

They've also taken to breaking long-established Committee norms.

For instance, last week, the Majority held a field hearing in Minnesota, the home state of the Boundary Waters, to discuss mining.

As Chair Stauber mentioned at the field hearing, he was disappointed that the Minority didn't attend.

But I would like to remind him that they gave us only a little over a week's notice.

When Democrats held the Majority, we often gave the Minority a month's notice or more to make sure they could plan to attend.

And community members noticed—press coverage after the hearing called out the fact that it was not a balanced discussion.

The hearing was supposedly an opportunity to hear from the community, but they certainly didn't want to hear from everyone.

Notably not on the witness list were the Chippewa Bands, whose lands and waters would be most impacted by mining pollution.

And of course, there was no testimony from any of the 70 percent of Minnesotans who are in favor of Boundary Waters protections.

I find it hard to believe that leaving these stakeholders out of the conversation was an accidental oversight.

And now, with today's hearing, my colleagues across the aisle are resorting to unconstitutional bills to get their industry-driven agenda across the finish line.

For a party that claims to be all about process, there seems to be a lot of finding ways to get around the rules.

By contrast, the mineral withdrawal we're discussing today is squarely within the administration's authority, and they followed all proper procedures to do it.

My colleagues say that the mining industry needs certainty—well this is certainty, the Boundary Waters watershed is off limits.

Rather than rehashing a settled score, I hope we can instead work together to reform the future of mining to make it more sustainable, modern, and predictable. But I'm concerned we have different visions for the future.

My vision is one that gives tribes the opportunity to provide input early and often, lets land managers decide where mining should occur, and provides a fair return for taxpayers.

Our clean energy future is not an excuse to extend mining industry destruction even further.

This is an opportunity to raise the bar for mining across the globe and demonstrate that some places, like the Boundary Waters, are simply too special to mine.

Mr. STAUBER. Ranking Member Grijalva, I really appreciate you bringing up the facts and the science. The fact is they are not even allowing the facts and the science to go forward in an Environmental Impact Statement in this case.

The Chair now recognizes the Full Committee Chair, Mr. Westerman.

Mr. WESTERMAN. Thank you, Chairman Stauber, and thank you for your leadership on this issue, for doing the field hearing, and for really going through a regular order process, getting the facts out, getting witnesses here. And, hopefully, we will be able to do a markup and get a bill on the Floor through regular order that has a lot of different input on it.

Senator Bakk, thank you for being here today, as well as all the witnesses. I want to ask you, Senator, having lived in the area and represented the area, why is a mineral withdrawal even required to prevent mining in this area of the Superior National Forest?

Mr. BAKK. Thank you for the question. I think what often gets lost is the fact that the Superior National Forest, of which the Boundary Waters is a portion, the forest is much larger than that, but the management plan for the Superior National Forest, mining is a permissible and desired use.

Mr. WESTERMAN. Exactly, and when Congress established the Boundary Waters Canoe Area, they put boundaries around the Boundary Waters and they said, "Here is an area that could be managed, where the resources can be used," and that is the law.

And we have the Administration coming in and saying, "No, we are going to withdraw the minerals from this area." And the law is that you can go in and develop these resources. But we have an administrative state that tries to usurp the will of Congress, which, really, if you can tell, probably gets under my skin.

Dr. Thorleifson, it was mentioned in testimony that the Boundary Waters just isn't the right place to build a mine. As a geologist, can you tell me where the right place to build a mine is?

Dr. THORLEIFSON. Well, I agree that the Boundary Waters is not a good place for mining. But our question today is how far upstream does the precaution need to extend, and——

Mr. WESTERMAN. I am going to get to that, but where is the right place to develop a mine?

Dr. THORLEIFSON. The right place to build a mine is where the activity is permitted, and where the rules are clear——

Mr. WESTERMAN. Or where the ore is available?

Dr. THORLEIFSON. Absolutely. The geology dictates where you build a mine——

Mr. WESTERMAN. It is not like we have a choice to go somewhere where there is not copper ore, or cobalt, or nickel and build a mine because you are not going to find any there.

And to my next point, this mine proposed is underground, isn't it?

Dr. THORLEIFSON. That is right.

Mr. WESTERMAN. I am going to ask you a really tough scientific question: Which way does water flow?

Dr. THORLEIFSON. North.

Mr. WESTERMAN. I mean, up or down? Towards gravity or away from gravity?

Dr. THORLEIFSON. Definitely down.

Mr. WESTERMAN. So, if you are below ground in the mine, can water flow up to the Boundary Waters from there?

And I know the concern is the tailings outside the mine, but we are talking about a dry stack tailings process.

As a geologist, what do you think the odds are that you would get any kind of runoff from this mine ending up in the Boundary Waters Canoe Area; and from an engineering perspective, all of the containment areas and check points that you have to have to prevent that?

And you can also talk about that in terms of the Canadian mines on the other side of the border that are using these processes. Have they had seepage into the Boundary Waters area?

Dr. THORLEIFSON. Well, that is a question that needs to be established by engineers. And through the environmental review, the company has produced a plan in which the sulfide content of the tailings would be very low. There would be precautions in place to ensure no seepage. And that needs to be verified. And we need to apply lessons that have been developed through industry.

For example, across the border in Canada, sulfide mines like Flin Flon, Thompson, Manitouwadge, Shebandowan, these are places where we have learned lessons—for example, the impact of smelters—and we have learned how to contain tailings to ensure that the tailings composition is such that there will be no impact.

Mr. WESTERMAN. How long does it take to permit a mine in Canada in this area?

Dr. THORLEIFSON. As long as it takes, which sometimes it is not very long.

Mr. WESTERMAN. About 3 years is what I understand.

Mr. Chura, you are talking about jobs, and Ms. Rom made a point about this ore might have to be exported to China to be refined. And although I believe that is incorrect, that the plan is to actually refine the ore in the United States, this chart tells the story.

[Chart.]

Mr. WESTERMAN. In 1995, we produced over 3 times more copper than China. Today, they produce about 11 times more copper than we do. They have 50 smelters and we have 2.

Here is a summary of a report from USGS and Commerce that says in America today we produce about $120 billion worth of ore, net of exports. When we refine that, the value of it becomes $900 billion. And when we manufacture things out of what has been refined, it is $3.7 trillion to the GDP.

So, what is the economic and jobs impact if we were to actually take this ore, and we could permit a refinery and do the refining and the manufacturing here, rather than exporting our wealth to China, who, by the way, is building a coal-fired plant every week so they can refine these metals from around the world and manufacture the stuff to ship back so we can make electric grids, windmills, solar farms, and electric vehicles?

Mr. CHURA. Yes, thank you for the question. If you look just at, like, one particular project proposed to provide 750 jobs, plus you have the spin-off jobs, about 2 to 1 there that benefit the community, if you want to put that in kind of a comparison, if you think about the populations of Ely and Babbitt, those jobs would employ nearly half of the population there.

So, the number of spin-off jobs would be significant. It would be great if we could do additional refining and processing in this country, to see that further expansion and kind of control of the supply chain, as well. It needs to start with mining, though. We need that ore, and this is an opportunity to extract that ore domestically, where we have sound provisions in place and where we have oversight, where we have a say in the process. That is an important piece of all of this, making sure that we have oversight, and strong laws and regulations in place.

Mr. WESTERMAN. Thank you.

I know my time has expired, Mr. Chairman. Thank you. And it is interesting that it is not that we went through the environmental permitting process and found out there were problems; you can't even go through the process because it has been usurped by an activist administration.

Mr. STAUBER. That is correct.

Mr. WESTERMAN. I yield back.

Mr. STAUBER. Thank you, Mr. Chair.

Representative Kamlager-Dove, you are up for 5 minutes. Thank you.

Ms. KAMLAGER-DOVE. Thank you, Mr. Chair.

Ms. Rom, the Campaign to Save the Boundary Waters works with a coalition of over 400 businesses, conservation and hunting and fishing organizations. So, how do you, local businesses and the Ely community, respond to the claims that mining in the withdrawal area would help the economy?

Ms. ROM. Well, it would be devastating economically to northern Minnesota and harmful to all of Minnesota.

And I would just like to say that since 2016, over four different processes and comment periods lasting over 454 days, 675,000 Americans have weighed in on whether or not there should be mining in the watershed of the Boundary Waters, and they have all said no. So, the vast majority of people in northeastern Minnesota, Minnesota, and America say no to copper mining, no to risk to the Boundary Waters. And all of them, or many of them, have an economic stake in this.

We have canoe manufacturers in southern Minnesota, in central Minnesota that rely on the Boundary Waters for their business. A polluted Boundary Waters would hurt them as much as it would hurt the Boundary Waters businesses in northeastern Minnesota, which is an amenity-based economy. People live there for a whole

variety of reasons. Tourism, yes, it is important, but it is only a part of what we are.

I had a friend who worked for the World Bank who lived just outside of my town. People from all over the world can live in this amazing place next to the Boundary Waters, bring their hard-earned dollars to our community and support our community. And they say they will move away if copper mining is developed in the headwaters of the Boundary Waters.

Ms. KAMLAGER-DOVE. Thank you. I guess it is safe to say that many of the businesses and community members that you work with, that their livelihoods would be directly impacted by the Twin Metal mines, correct?

Ms. ROM. Correct.

Ms. KAMLAGER-DOVE. To your knowledge, did your coalition have any heads-up about this legislation?

Ms. ROM. No.

Ms. KAMLAGER-DOVE. And in comparison, did those in your community have the opportunity to comment before the mineral withdrawal was completed?

Ms. ROM. Yes, and that is one of the processes I was talking about. Since 2016, when the Forest Service first asked the American people if it should consent to the renewal of the leases, at that time 74,000 Americans said no. And we have had time after time, eight listening sessions, to weigh in. It is generally about 98 percent opposition to copper mining in the headwaters of the Boundary Waters throughout three administrations: the Obama, the Trump, and the Biden administration.

Ms. KAMLAGER-DOVE. Did the mining industry have the opportunity to comment before the mineral withdrawal was completed?

Ms. ROM. Yes, they had equal opportunity.

Ms. KAMLAGER-DOVE. My colleagues say that they care about protecting the environment and addressing community concerns, but to me it seems like they are proceeding on behalf of the mining industry and not consulting at all with the people who feel that their well-being for clean water and for the opportunity to keep their business open, for the ability to fish, to hunt, and recreate will be challenged, if not devastated.

I have one more question for you, Ms. Rom, because you mentioned in your testimony that one of your grandparents was an iron ore miner, and one of your parents was a wilderness canoe trip outfitter. So, can you speak in these remaining seconds a little more about your relationship to the Boundary Waters and your relationship to mining in the region?

Ms. ROM. Sure. My grandfather, Casper Rom, was an immigrant from Eastern Europe who came over in 1892 to work in the iron ore mines around Ely, and he worked there until he actually was killed in a mine cave-in in 1918.

So, my father grew up as his ninth baby without a dad. And in those days there was no safety net from anybody. He went on to form a wilderness canoe outfitting business after he served in the Pacific as a naval officer in World War II. He wanted to share what he grew up with, with people from all over the world. And he did that.

And I grew up, as his daughter, one of his four children, I had three brothers, living over his business. It was our life. And I experienced meeting thousands of people from all over the country who came back out of the woods from canoe trips, wanting to talk about the life-changing experience they had.

So, I know the mining industry. I grew up with first iron ore mining and then taconite mining. My uncle, Frankie, had a sawmill and a chainsaw shop. And I started guiding canoe trips when I was 14. I am now 74, so it is a long time ago.

But needless to say, the Boundary Waters is incredibly important not only to me, but to the American people. And for 120 years the Federal Government and the State Government have promised the American people that they would keep it pristine, ecologically healthy, and intact not only for us, but for my children and my grandchildren and the children after them.

Ms. KAMLAGER-DOVE. Thank you, Ms. Rom.

And Mr. Chair, I yield back.

Mr. STAUBER. Thank you very much.

Mr. Lamborn, you are up for 5 minutes.

Mr. LAMBORN. Thank you, Mr. Chairman, thank you for holding this very important hearing.

According to International Energy Agency projections, material increases needed to secure a carbon-free economy are enormous. Lithium would need to increase by 4,200 percent, graphite by 2,500 percent, nickel by 1,900 percent, and other rare Earth minerals by at least 700 percent. These percentages go up even higher when trying to achieve these goals by 2040, which is the goal of numerous states and the Biden administration. For example, lithium would have to increase by over 13,000 percent under current consumption rates to reach the Biden administration's goals by 2040, according to an R Street study.

So, Dr. Thorleifson, these minerals have to come from somewhere. If they aren't mined here, where will they be mined?

Dr. THORLEIFSON. Thank you, Representative Lamborn.

I agree with you. We have a tremendous need for materials to facilitate the green economy, to sustain our national security, to sustain our way of life. They will come from somewhere. And the way to obtain these materials is not by lowering environmental standards, because——

Mr. LAMBORN. Well, where will they come from? That was my question.

Dr. THORLEIFSON. They will come from overseas, unless we produce them domestically. So, we must not lower environmental standards; we must not simply approve projects because we think we have to, to sustain the supply.

In reality, the default mechanism for obtaining these materials is to watch commodity prices rise, and then wait for certain countries to decide to go into production. And then we will be stuck paying more, and being dependent on their supply. The way to get these materials is to ensure a healthy and effective regulatory process. We need good information, and we need regulatory procedures that are not only clear, but predictable such that people know that they can carry a project through to completion, meet the requirements, and produce the materials that are needed.

Mr. LAMBORN. OK, thank you. Let me ask about China in particular.

The United States Geological Survey released its 2023 Mineral Commodity Summary a few months ago. According to this report, mineral imports made up more than one-half of the U.S. consumption of mineral commodities, and the United States was 100 percent net import reliant for 15 of those mineral commodities. China supplies 26 different minerals, of which the United States is over 50 percent import reliant, which is more than for any other country.

What are Chinese environmental protections like, compared to U.S. environmental protections?

Dr. THORLEIFSON. Broadly speaking, not as rigorous. And that applies more broadly around the world. So, we need to promote high environmental labor standards. We need to have good information such that these discussions are informed by good science. We need a regulatory process that means that the materials we need will come from places where they are meant to be from, and we don't wait for price spikes and dependence on overseas——

Mr. LAMBORN. If we didn't import these from countries like China, or Democratic Republic of Congo, or places which have horrible environmental protections or use child labor, or things like that, how much of these minerals could we produce domestically, were the environmental regulations, and we need to be responsible, obviously, but available so we could do responsible mining?

Dr. THORLEIFSON. Well, the short answer is more.

Certainly, we have the mineral potential in this nation that can support domestic needs, so long as we have an effective regulatory process that ensures that environmental standards are upheld, and that we facilitate efficient business operations to get projects permitted.

Mr. LAMBORN. Mr. Bakk, can you give us some specific answers on which minerals could be produced domestically that we are now importing from countries like China?

Mr. BAKK. Well, I think first we have to dismiss this premise that many have that somehow we can move to a renewable energy economy without mining. Mining is going to have to expand all over the globe. We will need every strategy to extract the metals that we need.

Minnesota is sitting on about 95 percent of our country's known nickel reserves, critical to our defense industry, to our medical device industry, to renewable energy. It is in Minnesota.

And I think the problem with the withdrawal is now we don't even get a chance to entertain a potential mine plan, a scoping document about what the potential environmental impacts might be, or how they might be mitigated.

Mr. LAMBORN. OK, let me interrupt, because my time is about up.

Should we only care about environmental responsibility in the United States, or should we care about other parts of the world?

Mr. BAKK. Well, everything that I have ever heard and read, and it includes even in Canada, is that the environmental regulations in the United States are much more stringent. I support them, but you have to have a process to go through in order to identify what

the potential impacts are, and to the extent you can mitigate them. And if you can't, then a mine shouldn't be permitted, but people should have the opportunity to go through the process.

Mr. LAMBORN. Thank you.

Mr. Chairman, I yield back.

Mr. STAUBER. Thank you.

Mr. Duarte, you are up for 5 minutes.

Mr. DUARTE. Thank you to all the witnesses today.

I am a legislator from California. And getting informed about Minnesota mining, and maps, and wetlands, and forests is something I have to rely on you for. I need your information to help make these decisions.

So, the first thing, I saw a beautiful wetland. I saw the canoe, the little islands of trees, there it is. This here.

[Slide.]

Mr. DUARTE. We are not putting a mine there, are we? No, we are not putting a mine anywhere really close to there. Anyone that wants to canoe there probably won't be able to see the mine from there, right? Anyone who wants to hunt, camp, backpack, buy bait and tackle can't see the mine from this location.

In fact, this location is up in this dark green area here, isn't it? That is a 3 million-acre forest, the Superior Forest. The proposed mine is this red spot here. And we are miles from that. That is 10 miles, for the majority of those canoeable lands there.

So, please, any of you, explain to me how the mine, located where that red dot is, is going to economically disrupt the naturalism through hundreds of thousands of million acres of that.

Go ahead, Ms. Rom, you are ready to roll.

Ms. ROM. That photo tells you, that is the Boundary Waters and Quetico, that area is 24 percent water.

Mr. DUARTE. OK.

Ms. ROM. It is interconnected water, groundwater, wetlands, rivers, lakes, streams. All of the water is flowing north.

Peer-reviewed scientific studies show that pollution from a Twin Metals mine in ordinary operation would flow into the Boundary Waters. People may not see it because it is pollution in the water. But that fresh water has very little in the way of base compounds or alkalines which buffer acid. The pH would drop, aquatic life would be severely damaged, killed. So, the consequences would be there, even if you can't physically paddle and see the mine.

Mr. DUARTE. Thank you. So, just north of this there are open pit mines. There is other mining going on in Canada that is adjacent to these same waters.

Ms. ROM. In areas that flow away from protected areas that don't flow into protected areas. And that is a key distinction.

Mr. DUARTE. OK. Mr. Bakk, you have represented this area for quite some time. Should we study this? Do the mining industries, the employees of Minnesota deserve to have this examined, deserve for this to go through scientific review to see if this can be done with appropriate scientific environmental precautions?

Mr. BAKK. Well, thank you. That is the problem with the withdrawal is we will never know because no one will ever be able to submit a mine plan to determine what the environmental impacts may or may not be. There is no process.

Mr. DUARTE. So, we have an arbitrary 20-year moratorium now on this mine.

Mr. BAKK. That is correct.

Mr. DUARTE. So, whatever the cost of putting in appropriate environmental precautions in today, not to mention geopolitical risks of not having our own domestic production of these resources as we move our economy to the green economy, with a 20-year moratorium we not only can't look at it today, whatever the economics come, whatever the geopolitical risks of having an insufficient supply of these critical minerals are, we can't look at this for 20 years. We can't begin to solve those problems and address Ms. Rom's and others' concerns because this thing has been taken off the slate for two decades.

Mr. BAKK. That is correct. And I think what people need to remember is the Boundary Waters is just a part of the Superior National Forest. Mining is banned in the Boundary Waters, but the Superior National Forest Management Plan says that mining is a desirable use in the forest. This mine is in the forest. It is not in the Boundary Waters, it is not in the buffer to the Boundary Waters. It is part of the Superior National Forest, where the management plan says mining is a desired use.

Mr. DUARTE. So, right now, for three administrations now, well, for four, or you said seven administrations or five administrations prior to the Obama administration we have been developing plans. We have been going through these desired uses of the Superior National Forest. We have been getting better at this. Obama canceled it. The next administration reinstated it. The current administration has canceled it.

So, any investor in developing the science, the technology to give us domestic mineral security with these types of minings is taken off the plate until the next administration—this thing is going to be ping-ponged for quite a while. We see the same thing with the Clean Water Act jurisdictions. It is just going to keep playing ping pong while we do not have any opportunity to use these resources to establish domestic mineral security.

Mr. BAKK. Well, there has been test drilling and exploration going on for decades in this region. And this——

Mr. DUARTE. Well, isn't the water already contaminated then?

Mr. BAKK. Not that I am aware of. And this prevents any kind of exploration at all, so——

Mr. DUARTE. Have our standards and technology gotten worse? I am sorry to interrupt. Have we gotten really bad at this in the last 20 years?

Mr. BAKK. There is no pollution that has ever been reported anywhere. And there are thousands, and thousands, and thousands of drill holes for thousands of feet deep, exploring what the resource is, because you can't build a mine unless you can show the investors and the banks what is down there. Nobody will finance it. So, the exploration is critically important. And to say that we can't even explore for the next 20 years in this region and find out what we all own down there is really problematic, and problematic to the country.

Ms. ROM. May I——

Mr. DUARTE. Thank you, sir.

I yield back.

Ms. ROM. May I comment, sir?

Mr. STAUBER. Thank you, Congressman Duarte.

And I think it bodes well to repeat what the senator just said. There is going to be no mining in the Boundary Waters or the buffer zone around it. And for purely political reasons the leases were removed without allowing an environmental assessment statement.

Mr. Gosar, you are up for 5 minutes.

Dr. GOSAR. Yes. Dr. Thorleifson, it is good to see you again. You state in your testimony that the proposed mine near the Boundary Waters would have no headframe, no smelter, no smokestack, no waste rock, no tailings pond nor tailings dam. It thus is difficult to reconcile the level of public concern with the project as described. Given your expertise regarding acid-generating sulfide minerals, why do you believe this project, as described, has minimal risk of water pollution?

Dr. THORLEIFSON. Well, the project, as developed, would recover sulfide minerals in their process. It would lead to negligible levels of sulfides in the tailings, and the tailings would be constructed to ensure stability and lack of seepage.

This needs to be rigorously reviewed and confirmed. There need to be precautions put into place to make sure that there is backup, should anything occur. So, the fulfillment of the regulatory process would be needed to confirm that lack of impact, and we would need to ensure that the mine wouldn't affect the first mile downstream from the mine and, therefore, certainly not affect the Boundary Waters miles downstream.

So, that is why the regulatory process is in place. That is why the engineering is in place, to confirm that there would not be impact.

Dr. GOSAR. I am going to compare it to my home state and Resolution Copper. I could make an argument that contamination of water in a desert environment is even more susceptible. So, why is it in Resolution Copper we are mandating technology that we are making water cleaner, cleaner, than we receive. Is that heresy? Is that even possible, Doctor?

Dr. THORLEIFSON. Sure, it is possible. And the entire process needs to make good environmental sense and good economic sense. And I think that the industries are committed to that, and we need regulators to ensure that it will happen, and we do.

Dr. GOSAR. See, I forgot that.

[Slide.]

Dr. GOSAR. I want to go back to this picture. The gentleman from California brought up water. Now, water runs down, doesn't it? It flows to the sea, at least the last I looked at it. So, if an open pit gold mine doesn't pollute, how in the hell is this going to pollute?

I mean, just for the sake of sanity for me, what is more caustic, gold mining or a copper mine?

Dr. THORLEIFSON. That depends on the configuration, and the environmental impact is a matter of the materials brought to surface and any water discharged from the mine. Elsewhere, waste rock from open pit mines can be a significant source of acid mine drainage. That is not going to happen here.

So, I admire people who are rigorous in ensuring that precautions are in place. I admire people who are completely committed to protecting the Boundary Waters. And we, as a professional community, need to work with the companies, with the regulators, with the sources of science to make sure that there will not be any impact on the Boundary Waters.

Dr. GOSAR. Well, and I am glad you brought that up, because it is part of our due diligence as citizens in that area, as well as the state, to make sure that they are doing everything that they have to, to do it right.

We keep hearing this mining processes that are antiquated, that are not being used anymore. And this other side will never tell us about where they want to mine. That is never the option.

So, when I went up there, I was thoroughly engaged. It was wonderful. I think it is something that we can chew gum and walk at the same time.

Is there a new technology out there, by the way, Dr. Thorleifson, on access to all the minerals within the ore in, like, a smelting process?

Dr. THORLEIFSON. Would you please repeat the question?

Dr. GOSAR. Yes. Are you aware of a new technique that is very green, that actually pulverizes the ore and extracts everything after ionization in which you get everything out of the ore and you are left with a silica substrate?

Dr. THORLEIFSON. Yes, there is a lot of new technology, and we have learned a lot of lessons. We used to use smelting. We don't do that. We now have hydrometallurgy, we have many processes, and we are adding processes. You can even use the tailings to capture carbon dioxide from air. So, technology is rapidly advancing and we can do this in a way that will avoid the impacts that are feared and ensure good jobs and metals for the nation.

Dr. GOSAR. Let me make one last statement. You are telling me this is peer-reviewed science that you are talking about? This actually exists? We are actually utilizing this type of technology, not this antiquated thing that we are being told about?

Dr. THORLEIFSON. Absolutely. Regarding the methods, absolutely.

Dr. GOSAR. I thought I was living in the 1950s. Thank you.

Mr. STAUBER. Thank you, Representative Gosar. Representative Tiffany from the great state of Wisconsin, you are up for 5 minutes.

Mr. TIFFANY. Well, Senator Bakk, you may have lit the next border war between Wisconsin and Minnesota today with your claim that the snowmobile was invented in Minnesota, and we will set that aside here.

Ms. Rom, the study you referenced in your opening remarks, was that peer-reviewed?

Ms. ROM. Are you talking about the hydrology study? It was. It was peer-reviewed and published.

Mr. TIFFANY. OK. And it has been published?

Ms. ROM. Yes.

Mr. TIFFANY. And can you share that with us?

Ms. ROM. I would be happy to.

Mr. TIFFANY. In scientific journals, it was published?

Ms. ROM. Yes.

Mr. TIFFANY. OK. That would be terrific.

Is your goal to end mining?

Ms. ROM. I beg your pardon?

Mr. TIFFANY. Is your goal to end mining?

Ms. ROM. Of course not, no.

Mr. TIFFANY. So, where should we mine?

Ms. ROM. Well, first of all, I think it is important to recognize that the amount of nickel and cobalt that would come from a Twin Metals mine is insignificant in terms of reaching our goals with green energy.

Mr. TIFFANY. What do you define as insignificant?

Ms. ROM. We need to mine in places that are not extraordinarily valuable and vulnerable, which is what this place is.

Mr. TIFFANY. Where are those places that are not valuable and are not vulnerable?

Ms. ROM. There are places all around the world and in the United States that qualify for that.

Mr. TIFFANY. Name one for me.

Ms. ROM. For which type of mining?

Mr. TIFFANY. You name it.

Ms. ROM. Well, we have taconite mining in northeastern Minnesota that has been there since the 1950s.

Mr. TIFFANY. Are there any places that we can mine that are new places around the United States of America?

Ms. ROM. Well, actually, taconite mining is expanding in northeastern Minnesota. The Walz administration just recommended new state leases to expand the Hibbing taconite facility. So, it is expanding in northeastern Minnesota.

I am really not that familiar with mining around the rest of the country, but we have taconite in Minnesota, and it is broadly supported by the people of Minnesota.

Mr. TIFFANY. Yes, so we can taconite mine, but not the other stuff.

Ms. ROM. Well, we have no other kind of mining in Minnesota right now.

Mr. TIFFANY. Do you agree with the conversion to wind and solar for our energy sources?

Ms. ROM. I am sorry, I have bad hearing, so please repeat your question.

Mr. TIFFANY. Do you agree with the conversion to wind and solar to produce energy here?

Ms. ROM. I do, and I believe we can get there without destroying special places on our planet.

Mr. TIFFANY. So, how are we going to have the minerals if we don't mine them here?

Ms. ROM. We have to mine. We have to both recycle—right now in Minnesota we only recycle 23 percent of our e-waste. And we have to, in the right places under the right conditions, mine for more metals. I agree with that.

Mr. TIFFANY. So, where is the right place to get that copper, lithium, and all those? Where is the right place in America to mine those?

Ms. ROM. In places that are not uniquely vulnerable, such as the headwaters of the Boundary Waters, and extraordinarily valuable.

Mr. TIFFANY. Where is that place that is not as valuable as——

Ms. ROM. I would look for dry environments. Part of the problem of northeastern Minnesota, especially in the watershed of the Boundary Waters is that it is extraordinarily wet.

Mr. TIFFANY. So, Resolution Copper, as the Ranking Member will tell you, that mining should not go there in a dry area in Arizona. That is the question. Where are we going to do this?

Are you familiar with the Eagle Mine in northern Michigan?

Ms. ROM. Yes, and that mine is currently polluting, and that is not a good example of mining in the northern tier.

Mr. TIFFANY. Have you been there?

Ms. ROM. No, but I have read the reports on its violations of——

Mr. TIFFANY. Would you like to do a tour? Would you like to do a tour of the Eagle Mine?

Ms. ROM. Sure.

Mr. TIFFANY. Because I would be happy to take you there. Did you know the Eagle Mine is built underneath a river?

Ms. ROM. I know it is near the Salmon Trout River.

Mr. TIFFANY. So, you are saying it is polluting?

Ms. ROM. That is what the official government records demonstrate.

Mr. TIFFANY. Would you produce those official government records for us?

Ms. ROM. I would be happy to do that.

Mr. TIFFANY. That would be terrific because the people that I talk to in the Upper Peninsula, which are our neighbors, they say that this is modern 21st century mining, and we do not pollute.

Ms. ROM. So, it is a very small mine.

Mr. TIFFANY. Are they lying to us, Ms. Rom?

Ms. ROM. It is a very small mine. Part of the problem we have, and which I have been trying to explain today, is that, for example, Minnesota's standards for what you can do to, say, example, water quality and discharge——

Mr. TIFFANY. Ms. Rom, I only have 40 seconds left, and I have a couple of other questions.

Ms. ROM. OK, I am sorry.

Mr. TIFFANY. Are tourism and industry mutually exclusive?

Ms. ROM. No, we have high-quality small-batch manufacturing in my hometown, and we are very proud of that.

Mr. TIFFANY. So, your neighbor in Ely testified last week when I was in northern Minnesota that we can do both. We can mine, and Mr. Baltich, he said, "We can mine and we can have tourism, and we have been doing it for decades."

Ms. ROM. Well, we have taconite mines.

Mr. TIFFANY. Is he wrong?

Ms. ROM. Well, I don't know what he was talking about in terms of mining, but we do have taconite mining. That is a fact. And we also have a robust outdoor rec business that employs about 22,000 people, $1.5 billion in annual revenue. That is a big part of our community.

Mr. TIFFANY. Mr. Baltich says he does better with his tourism business over the decades when industry is doing well also. Is he wrong?

Ms. ROM. I don't know, really, his business model. I really don't.

Mr. TIFFANY. We can mine everywhere except in my back yard. That is the message we get. Not in my back yard.

I yield back, Mr. Chairman.

Mr. STAUBER. Thank you, Mr. Tiffany.

And just for the record, the mine ban that was put on by the Biden administration does include taconite.

Mr. Collins, you are up for 5 minutes.

Mr. COLLINS. Thank you, Mr. Chairman, and I want to thank you for having us on that trip. I am going to take just a couple of minutes to rant. I may have a question, and maybe I don't.

When I look at things, I look at it from a business person standpoint. I look at what the problem is and what the solution may be to fix that. And I am going to just tell you all what I saw from a good old Georgia southern boy that went to Minnesota. I saw a small town up there that was being destroyed. I saw second, third, fourth-generation people up there that were very proud of what they do, but they were also extremely concerned that what they do best is being destroyed.

And they also made a very valid point that they cannot make it on tourism alone, that tourism and mining go hand in hand.

I also saw mining companies up there and talked to them, and they informed us that the goalposts kept moving. Every time they would get a permit or get some portion of the EPA review finished, they were either getting sued by environmentalists or the goalposts were being moved so that they had to continue to review what they were trying to get permitted. Endless litigation.

I also saw mines up there and talked to one person that said that mining on state land was a whole lot easier to get permitted for the same thing, just a difference in Federal and state lands.

I also heard that that area is sitting on the largest deposit in the world for nickel and copper, the largest deposit. As a matter of fact, the miners in this area set the global standards on how to mine.

You can't make this stuff up. It just doesn't make common sense, what I am sitting here reading.

The other thing that I didn't see was a single Democrat on that trip who also had the opportunity to go up there and see firsthand. This is our job. What is going on? And to see those people and face them eye to eye, and understand what they are going through, and what they feel, and get their opinions on mining.

So, Mr. Chairman, the problem that I saw is we have an Administration that is focused on demanding that we go green, an overreach, overarching Federal Government that wants to keep Americans out of work, use China, OK with that, use child labor, and destroy a town up there.

We need to get the Federal Government off their backs is what we need to do, and the solution to that is H.R. 1, Lowering Energy Costs Act. We need to get that passed. We need to get that passed and let those folks go back to work.

Mr. Chura, did I hit the nail on the head?

Mr. CHURA. I agree with your comments here today. And I also want to say that those that oppose mining don't have a monopoly on the love for the Boundary Waters and protecting the Boundary Waters. Those that are working in the mines, those that work and

live around there and support mining equally love and respect the Boundary Waters, and want to see it protected.

The United States is the No. 1 consumer of critical minerals, and I feel strongly that we have an obligation and a responsibility to procure those here domestically to serve our needs.

Mr. COLLINS. Thank you, Mr. Chairman. I would like to yield to Mr. Westerman.

Mr. WESTERMAN. I thank the gentleman from Georgia.

And Mr. Thorleifson, on any kind of storage facility tailings operation, would there be an NPDS permit on that, like a stormwater discharge permit?

Dr. THORLEIFSON. Well, these things are thoroughly regulated from multiple perspectives——

Mr. WESTERMAN. So, there would be extreme monitoring, discharge permits, extraordinary engineering measures put in place?

Dr. THORLEIFSON. Certainly.

Mr. WESTERMAN. So, it is not just some willy-nilly push stuff off on the side and let it leach out and drain into the water system.

Dr. THORLEIFSON. I can assure you.

Mr. WESTERMAN. Ms. Rom, if I just came in and listened to your testimony or maybe sat down and visited with you, I would get the impression that, if there is 1 ounce of copper mined in this area, then the Boundary Waters Canoe Area is toast. Is that your position?

Ms. ROM. I am sorry, I have poor hearing.

Mr. WESTERMAN. It might be the Southern. Is it your position that if there is any copper or nickel or cobalt mined in Superior National Forest, that the Boundary Waters Canoe Area is over as we know it today? Can mining and the Boundary Waters not co-exist?

Ms. ROM. I am still not sure I heard your question, but the area that is covered by the mineral withdrawal is the watershed of the Boundary Waters which is a portion of the Superior——

Mr. WESTERMAN. You didn't understand my question. Is it possible to mine and still have the beautiful recreation area at the same time, or do you think it is an either-or situation? Because you present the case that it is either mining or it is tourism, but the two can't co-exist.

Ms. ROM. Yes. And we have a much larger economy than tourism, just so you know.

Copper mining in this place with this tiny, minuscule amount of metals in a water-rich environment——

Mr. WESTERMAN. Wait, hold on a second.

Ms. ROM [continuing]. Is risky.

Mr. WESTERMAN. No, it is my time. Hold on a second.

Ms. ROM. OK.

Mr. WESTERMAN. You said a tiny, minuscule amount, and Mr. Collins just stated that it is the largest deposit in the world. Are you aware that the World Bank says that we have to mine more copper in the next 25 years than we have mined in the history of the world, and there is no way to meet those demands simply by recycling?

Ms. ROM. Sure, but there is a little bit of apples and oranges going on. Some people are talking about the Midcontinent Rift and the Duluth Complex, which is vast, and the metals content in that vast area. The withdrawal area is a small portion of that. And a Twin Metals mine would produce, at most, 1.5 percent of the U.S. current demand as of 2019 in cobalt.

So, it is insignificant in terms of U.S. independence. We would damage the Boundary Waters and still have to import cobalt.

Mr. WESTERMAN. Dr. Thorleifson, do you agree with that?

Dr. THORLEIFSON. Well, I find the numbers to be somewhat higher: 5 percent in some cases, 10 percent in some cases. And a healthy supply relies on multiple mines, and these mines are in a position to produce 5 percent, 10 percent of supply. And if we need to clarify that, let's do that, Becky.

Ms. ROM. Yes, and I think you are talking again about the bigger ore body, not the mine site.

Mr. WESTERMAN. I yield back to——

Mr. COLLINS. Thank you, Mr. Chairman. Sorry for going over.

Mr. STAUBER. Senator Bakk, with just a little time remaining, do you want to follow up on the Chairman's question? Do you want to make a comment?

Mr. BAKK. Well, the problem with the withdrawal is we can't even do any exploration to continue to discover what the resource is. But the Duluth Complex in northeastern Minnesota is massive. It is one of the largest complexes in the world.

It is true, the Twin Metals part is a small piece of the mature deposit of the Duluth Complex. But what we need to do is go through the environmental review process, identify, if we can, a safe way to do it. And if we can't do it safely, then we shouldn't do it. And then others will follow, once the first one has been developed and we have figured out a safe way to do it. And northern Minnesota will make a huge contribution to renewable energy for not only the country, but around the world.

There is a tremendous opportunity here. All I think we are asking is let us go through the environmental review and figure out if we can do this safely or not, and we are being pre-empted from doing that.

Mr. STAUBER. Thank you very much. And before I go into my closing comments, Mr. Grijalva would like a little bit of time.

Mr. GRIJALVA. Thank you. I would just like to enter into the record the statement for the record from the Department of the Interior in opposition to House Resolution 34, strongly opposing any action to reverse the locally-driven efforts to protect and conserve this critically important, fragile landscape, and acknowledge that the resolution is unconstitutional, and therefore will have no effect.

I have experience with withdrawal around the Grand Canyon. The Obama administration, I think we are in our 12th, 13th year now of that moratorium, withdrawal from mining, uranium mining, and also in response to the uranium contamination that the Navajo Nation was still struggling with and continues to struggle with.

And also the foresight of that withdrawal, as we encountered the drought that we have in the Southwest and the primary source of water for six states, and 40 million people, and all the industry.

And it is the Colorado River, then that watershed protection, as we are talking about here today, has become critical and, in hindsight, an absolutely important science-based decision that was made by that administration at that time, even though some of my colleagues on this Committee, my friend from Arizona, Mr. Gosar, lost his thing when this happened.

The fact remains that thinking ahead, special places, and intended and unintended consequences should be the drive in this decision.

And I go back to my point that I hope we were spared having to revisit this, but here we are. And I think it opens up a much broader discussion about vision and what I said at the beginning, that mining law of 1872 that continues to drive decision-making.

With that, I yield back and thank you very much, sir.

Mr. STAUBER. Thank you, Ranking Member Grijalva.

I thank all the witnesses for their valuable testimony and our Members for their questions today.

The members of the Subcommittee may have some additional questions for the witnesses, and we will ask you to respond to these in writing. Under Committee Rule 3, members of the Committee must submit questions to the Committee Clerk by 5 p.m. on Monday, May 15. The hearing record will be held open for 10 business days for these responses.

Before we gavel out, I would like to enter the following into the record: a letter from the area's State Representative, Roger Skraba, in support of my legislation; a letter from the rest of the Iron Range delegation in support, including State Representatives Spencer Igo, Ben Davis, Roger Skraba, Justin Eichorn, and Senator Rob Farnsworth; a letter in support from the International Union of Operating Engineers Local 49; a letter in support from the Range Association of Municipalities and School; a letter in support from Advanced Energy United, a national clean energy trade association; a letter in support from Minnesota Mining; a letter in support from Conservationists with Common Sense; a letter in support from Global Minerals Engineering; a letter in support from the National Mining Association; and a letter to the editor in the Duluth News Tribune by geologist Rens Verburg discussing how the dry stack tailings method renders mine drainage impossible.

[The information follows:]

Minnesota House of Representatives

May 10, 2023

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Dear Committee Members:

I write to you today to express my strong support for both House Concurrent Resolution 34 and proposed legislation that would undo the Biden Administration's unilateral decision to cancel mineral leases on Minnesota's Iron Range and to rescind the Department of the Interior's Public Land Order No. 7917 which effectively blocks development of mining operations across 225,504 acres of land in Northeast Minnesota for the next 20 years.

If these orders remain in effect, the communities, families, schools, businesses, and entire region I am so honored to represent in the Minnesota House of Representatives will be devastated.

Mining is part of our past and in order for our communities to reach their full potential, it needs to be a part of our future as well. Minnesota's Iron Range has been safely mining for more than 130 years.

Here in Minnesota, we have the best workforce in the world with some of the highest environmental standards. The copper, nickel, cobalt, lithium, and many other precious materials needed to produce modern technologies are beneath our feet here in Northeastern Minnesota. There is no need for the Biden Administration to tie one hand behind America's back and force us to rely on foreign nations for these materials when we can safely mine them right here on the Iron Range.

Failing to act means that my communities will lose out on billions in private investments, thousands of good-paying union jobs, and billions in tax revenues that support our schools.

Again, because of the far-reaching implications the Biden Administration's actions have on the communities and region I represent, I ask you to support both House Concurrent Resolution 34 and the legislation before you today. We cannot afford to wait any longer.

Sincerely,

ROGER SKRABA,
State Representative
House District 3A

Minnesota House of Representatives

May 9, 2023

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Dear Committee Members:

As members of Minnesota's Iron Range Delegation, our collective legislative districts represent Minnesota's Iron Range where safe mining has supported our communities for more than 130 years.

In January 2022, the Biden Administration unilaterally canceled two decades-old mineral leases on Mi1U1esota's Iron Range. One year later, the Department of the Interior issued Public Land Order No. 7917 which effectively blocked development of mining operations across 225,504 acres of land in Northeast Minnesota for the next 20 years.

These actions will cause generational harm to our communities if they are allowed to remain in effect. That is why we are writing to you today to express our bipartisan support for both House Concurrent Resolution 34 and the Superior National Forest Restoration Act that would undo the mineral withdrawal and reinstate these longstanding mining leases.

If you fail to act, the Iron Range will lose thousands of good-paying union jobs, billions of dollars in future investments for the people of Northeast Minnesota, and billions of dollars in tax revenues that support students through Minnesota's School Trust Lands.

The Iron Range is home to one the richest mineral deposits in the world and could be a crucial domestic supplier of copper, nickel, cobalt, lithium, and many of the precious materials needed for our modern world. These metals and minerals are needed for electric vehicle battery production, renewable energy projects, smartphones, defense systems, and many other modern technologies.

Blocking the mining of these minerals in Minnesota runs in direct contradiction to the Biden Administration's stated goal of increasing domestic mineral production and would further America's dependence on foreign nations while leaving us vulnerable to disruptions to global supply chains.

Given the far-reaching implications the Biden Administration's actions have on the communities we represent and the importance of establishing robust domestic mineral production to build the economy of tomorrow, we urge you to support both aforementioned items that are before the committee today.

Sincerely,

REP. SPENCER IGO
Asst. Minority Leader, District 7A

REP. BEN DAVIS
District 6A

REP. ROGER SKRABA
District 3A

SEN. JUSTIN EICHORN
Asst. Minority Leader, District 6

SEN. ROBERT FARNSWORTH
District 7

INTERNATIONAL UNION OF OPERATING ENGINEERS
Local 49

May 10, 2023

Hon. Pete Stauber, Chairman
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Re: House Concurrent Resolution 34

Dear Chairman Stauber:

The International Union of Operating Engineers, Local 49 (Local 49) strongly supports House Concurrent Resolution 34. Local 49 agrees with this legislation's aim to rescind PLO 7917, because from the start we have disagreed with a withdrawal of lands and mineral rights in northeast Minnesota from future leasing and potential development. As a construction labor union comprised of over 14,500 heavy equipment operators, mechanics and stationary engineers working in Minnesota, North Dakota, and South Dakota. Many of our members live in this region and would likely play a major part in the construction and maintenance of the potential projects this withdrawal has impeded.

We support this resolution because it corrects the mistakes of PLO 7917's withdrawal of lands. This withdrawal process did not consider any of the science or data from the Twin Metals Minnesota mine proposal, a collection of over 10 years of hydro-geological and environmental studies, engineering, community engagement and design, nor would it consider the specific information pertaining to any other project proposed to be sited on the withdrawn lands for the next 20 years. The only way to properly determine whether mining can be done safely is by thoroughly examining the facts behind a specific mine plan, such as the one from Twin Metals that has been available for review since the company submitted it in 2019. The current land withdrawal under PLO 7917 supposes a level of risk for a project that is based on generic and out of date mining practices. This process completely disregards innovations in mining process and technology and increases to environmental safeguards proposed by applicants that can mitigate these risks.

By rescinding the 20-year withdrawal of land this resolution will allow potential projects to prove, through a specific mine plan, that they can safely and legally build their project. If these projects are again allowed to move forward, those that can fulfill Minnesota's rigorous environmental and labor standards will have a substantial positive socioeconomic impact on northern Minnesota. These proposed projects have the potential to create thousands of jobs and billions of dollars in future investment. Our members have a long history building and maintaining mines to meet the stringent standards that are applied to Minnesota mining projects. Our members have a lot at stake to ensure these standards are met, as many of these projects reside in the communities where they live.

Rescinding this withdrawal will also reopen the potential of accessing a significant domestic source of critical minerals needed to combat the climate crisis with technologies like electric vehicles, wind turbines, solar panels, and energy storage. Climate change is the most imminent and concerning threat to Minnesota's wilderness areas, and mining is crucial in supporting the technologies we need to mitigate the negative effects of the climate crisis. The blanket withdrawal of these lands from exploration and development of Federally owned minerals to protect and preserve its natural resources is only serving to accomplish the opposite outcome. These minerals are critical to our ability to combat the severity of climate change effects on all our natural environments, including the Rainy River watershed. This withdrawal serves only to stall our nation's efforts to combat climate change.

Additionally, mining these minerals in the United States, and reducing our dependence on foreign sources of these materials, is vital for shoring up our supply chains and bolstering our national security efforts. The Biden Administration's supply chain assessment released in February 2022 found that "over-reliance on foreign sources and adversarial nations for critical minerals and materials posed national and economic security threats." Along with these security concerns sourcing minerals locally eliminates the immense costs, both monetary and environmental, of transporting vast amounts of raw materials across the globe. Taking the critical minerals available in northeast Minnesota off the table for development with a blanket withdrawal completely contradicts our nation's long-term priorities.

We urge the adoption of House Concurrent Resolution 34 to correct what we feel was a mistake caused by the withdrawal of lands and mineral rights in northeast Minnesota from future leasing and potential development.

Thank you for your time and consideration.

Sincerely,

JASON A. GEORGE,
Business Manager—Financial Secretary

Range Association of Municipalities and Schools (RAMS)

May 9, 2023

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Dear Congressman Stauber and Congresswoman Ocasio-Cortez:

The Range Association of Municipalities and Schools (RAMS} is an advocacy organization formed in 1939 that has been representing the best interests of communities and public schools that reside within the boundaries of an area known as the Taconite Assistance Area of northeastern Minnesota. This area includes the Rainy River Watershed as well as all active Taconite mines in Minnesota that produce over 80 percent of the domestic iron ore in our nation. The Iron Range has been mining for 139 years without any significant environmental disasters and we believe that we are the best environmental stewards of our own "back yard".

Congressman Stauber's proposed legislation titled Superior National Forest Restoration Act is a bold action that will rightfully restore our region by removing a 20-year ban on mineral exploration while also releasing over 225,000 acres for access once again. Reinstatement of federal leases that were wrongfully removed is another important provision of the legislation. Most important is the prohibition of judicial review of those leases, as frivolous, time consuming and expensive litigation has been the primary means of anti-development crusaders for the past two decades as they insist that precious mineral extraction will obliviate the entire region.

The RAMS Board of Directors consists of twenty-two publicly elected officials from township supervisors, city councils and school board directors. These public officials understand the importance of our mining industry, our timber industry as well as our tourist industry. From our perspective, they all do better when they all are working at full capacity. The opportunity in northeastern Minnesota to capitalize on the rich precious mineral deposits found in the Duluth Complex is one that we must pursue if we are to meet our carbon free goals in 2040 as established by our Minnesota legislature. All the precious metals needed for the green economy, the EV auto revolution, the solar and wind energy transition, are in the Duluth Complex. As local community leaders we would never support an industry that cannot meet or exceed all established environmental standards, because THIS IS WHERE WE LIVE, WORK, and PLAY. We are not going to ignore any industry that does not meet OUR STANDARDS for safe working conditions, livable working wages and maintaining a clean environment.

RAMS speaking on behalf of the 78,000 residents of our region, strongly supports the efforts of Congressman Stauber with his proposed legislation as well as the utilization of House Concurrent Resolution 34 that will allow for the nullification of Public Land Order #7917. As evident in the hearings when Secretary Haaland testified to not knowing that there were "critical minerals" located in the withdrawal area, this needs to be overturned so that a complete review of the Mine Plan of Operation submitted by Twin Metals is examined and vetted via the NEPA process as prescribed by law.

RAMS has a motto; "ONE RANGE—ONE VOICE" and we are speaking loudly and proudly in our support for the Superior National Forest Restoration Act as proposed by Congressman Stauber and we ask all elected officials to hear our voice, hear our message and vote in support of following the right of due process in this matter.

On behalf of the RAMS Board of Directors,

STEVE GIORGI,
Executive Director

ADVANCED ENERGY UNITED

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Dear Committee Members:

Advanced Energy United is a national association of businesses working to achieve 100% clean energy and electrified transportation in the United States. We represent a diverse array of companies that manufacture, develop, and operate clean generation, energy storage, electric vehicles, efficiency services, and other technologies that comprise the advanced energy industry.

As an industry, we recognize the need to increase the production of critical minerals, including copper, nickel, lithium, and cobalt, for the U.S. to make the transition to 100% clean energy and electrified transportation at speed and scale. The U.S. should work with allies around the world to ramp up international production, but to build robust, reliable supply chains to support and sustain the expansion of American advanced energy manufacturing, we must also ramp up domestic mining and processing of these resources. The Iron Range is home to some of America's, and the world's, richest deposits of critical minerals, including many of those mentioned above. As such, it can serve as the U.S. backbone of a clean energy revolution, just as the Range has done for prior eras in American industrial history.

At Advanced Energy United, we understand and support the need to maintain rigorous environmental protections as the U.S. expands production of critical minerals. Indeed, we would advocate that policies that increase domestic production should be paired with smart reuse and recycling policy, reducing the need for additional extraction over the long term. In our estimation, approval of House Concurrent Resolution 34 does not undercut state or federal environmental regulations that projects must meet.

Such projects should likewise benefit the communities in which they are located throughout the process of development and operation. It is our understanding that potential mining and processing projects in this area will produce substantial community benefits in the form of extensive economic investment and job growth for decades to come, and, as such, enjoy significant support.

For all of these reasons, Advanced Energy United supports House Concurrent Resolution 34. We welcome any additional questions the Members may have.

Sincerely,

HARRISON GODFREY,
Managing Director

MiningMinnesota

May 11, 2023

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Congressman Stauber and Congresswoman Ocasio-Cortez:

As the Executive Director of MiningMinnesota, I am writing to share our organization's support for both House Concurrent Resolution 34 and the draft legislation "Superior National Forest Restoration Act."

MiningMinnesota is committed to promoting respectful, constructive conversations about sustainable and responsible mining of nonferrous metals in our state. Our organization works with local citizens, businesses, and other organizations to cultivate healthy dialogue surrounding mining, particularly needed as Minnesota and our nation move forward with energy goals that necessitate greater amounts of metals to power our world than are currently produced.

Our members are deeply concerned that the critical discussions we need to be having as a country about the ethical sourcing of materials to support the energy transition are being stopped short by sweeping actions such as the federal minerals withdrawal. The complex conversations must continue regarding those resources and these pieces of legislation support that mission.

Respectfully,

JULIE LUCAS,
Executive Director

Conservationists with Common Sense (CWCS)

Hon. Pete Stauber, Chairman
Hon. Alexandria Ocasio-Cortez, Ranking Member
House Natural Resources Committee
Energy and Mineral Resources Subcommittee
1324 Longworth House Office Building
Washington, DC 20515

Chairman Stauber and Ranking Member Ocasio-Cortez:

We write to you today in opposition to Interior Secretary Haaland's withdrawal of 225,504 acres of the Superior National Forest in northern Minnesota. This action would ban mining of minerals for 20 years in the Duluth Complex which has abundant deposits of copper, nickel, cobalt, taconite, and other PGE group metals.

My husband and I live on Fall Lake which is partly in the Boundary Waters. As such, Fall Lake is part of the Rainy River Watershed. Water flows from Birch Lake to White Iron Lake to Garden Lake and then comes to Fall Lake over Kawishiwi Falls and right to our shoreline. From Fall Lake, it flows into Newton Lake and Basswood Lake as it heads further north through the Boundary Waters.

The Rainy River Watershed also receives water from Dunka Pit near Birch Lake, a higher sulfide mine pit that has been monitored since 1977. Yet there has been no impact on Birch Lake or the Boundary Waters in all these years since.

Exploration of copper/nickel in the Ely area has been ongoing since the 1940s and 1950s. We remember well the discussion of INCO's mining plans in the 1960s and 1970s, but no mining was started. The timing wasn't right, and neither was the technology to mine it safely.

We need to acknowledge the environmental movement of the 1970s that led to the passage of the Clean Water and Clean Air Acts. We are thankful that the copper/nickel projects proposed in the 1960s never moved forward. Mining technology has advanced over the past 50 years. We now have strict mining regulations to assure mining can be done safely regarding our environment.

We thank Congressman Pete Stauber for bringing the Subcommittee on Energy and Mineral Resources field hearing to the Iron Range. While several Republican members attended, it is shameful Congresswoman Ocasio-Cortez, nor any other Democrat member of the subcommittee, didn't bothered to join their Republican colleagues. They could have learned how important mining and our environment are to all of us.

We thank Congressman Stauber for introducing House Concurrent Resolution 34 to follow Section 204(c) of the Federal Land Policy and Management Act of 1976 and nullify the withdrawal.

We support the Superior National Forest Restoration Act, which would reinstate Twin Metals' federal leases and allow the environmental permitting process to move forward for Twin Metals and stop frivolous lawsuits. Other states obtained their permit to mine in less than ten years. The political football of restricting and banning companies from moving mining projects forward must end.

The Twin Metals project can and should move forward, just like Eagle Mine in Upper Michigan. Eagle Mine is an underground copper mine ten miles from Lake Superior, the largest freshwater lake in the world! They have been in operation for nearly ten years with no impact on Lake Superior. We can thank modern mining technology.

Our Minnesota Senators Klobuchar and Smith, and Governor Walz must acknowledge we need the minerals, and we can mine these minerals safer than countries that have little environmental regulations or safety regulations.

Minnesota is rich in God-given mineral resources and the past fifty years has given us technology to mine them safely.

Sincerely,

DOUG MCREADY &
NANCY MCREADY
CWCS President

GLOBAL MINERALS ENGINEERING

May 10, 2023

Andrew Morley
Energy and Natural Resources Policy Director

Hon. Pete Stauber, Chairman
House Natural Resources Committee
Energy and Mineral Resources Subcommittee

Re: Comments in Support of House Concurrent Resolution 34 and Rep. Stauber's Bill, the "Superior National Forest Restoration Act"

Dear Mr. Morley:

Global Minerals Engineering fully supports HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres. We also fully support the "Superior National Forest Restoration Act."

Global Minerals Engineering previously submitted comments on the Rainy River Watershed Mineral Withdrawal Application on January 18, 2022, and August 10, 2022. Herein I reiterate and elaborate on several points, testifying to the dangers to the U.S. economy, national security, and green energy goals that will result with the ban on leasing and development of strategic critical minerals in the Rainy River Watershed on federal land.

We were appalled by the reckless mineral withdrawal of 225,504 acres of the Superior National Forest within the Rainy River Watershed by the Secretary of the Interior. We have a world-class environmental review and permitting process in place in the United States and in Minnesota. Mineral exploration and mining taking place outside the Boundary Waters Canoe Area Wilderness (BWCAW) should be evaluated individually based on established State and Federal environmental review processes and regulatory tools. No broad, arbitrary restrictions on mining should be placed on any part of the Rainy River watershed that is outside the BWCAW and the long-established Mining Protection Area.

The mineral withdrawal is situated within the Duluth Complex mineral deposits in northeastern Minnesota, home to some of the largest copper, nickel, and cobalt resources in the world, along with platinum, palladium, titanium, vanadium, and gold. Within these undeveloped resources lies the world's 3rd largest nickel resource (95% of the U.S. resource), the world's 2nd largest copper resource (34% of the U.S. resource), 88% of the U.S. cobalt resource, and 75% of the U.S. platinum group metals (PGMs) resource. In addition, the underlying bedrock of the Rainy River Watershed contains rare earth elements and lithium potential. Minnesota is poised to become a global leader in supplying these metals essential to our way of life, critical to our nation's defense and economic security, and necessary to build green energy technology, including electric vehicles. Minnesota is lucky to have this mineral resource available. Only Russia and South Africa have similar bedrock containing these Cu-Ni-PGMs metal resources.

Currently, the U.S. is highly reliant on imports of many mineral commodities whose production is concentrated in a few countries, including Africa, Russia, and China, where environmental and safety standards are substandard to those in place in the U.S., resulting in the most severe environmental damage to the planet and the worst violations of human rights. The demand for electric vehicles will trigger a global shortage of copper, nickel, and cobalt and we cannot be asking Russia and China for more nickel and cobalt.

The federal administration ordered the Department of Defense to consider five metals as essential to national security under the Defense Production Act because of their importance to battery technology. These are nickel, cobalt, manganese, lithium, and graphite, all of which are found in Minnesota. A 2021 White House supply chain review recommended the federal government invest in a domestic nickel refinery. This mineral withdrawal is inconsistent with these initiatives. The delay in exploration and mining in the Rainy River Watershed is costing us greatly. Without Minnesota minerals, we will only become more dependent on foreign nations with nefarious goals.

We need to look to our future. The U.S. needs a reliable domestic supply chain to support itself with these critical minerals. Currently producing over 85% of the U.S. iron ore, Minnesota has a rich and safe history of mining on the Mesabi Iron Range for over 130 years, while having some of the cleanest air and water in the nation. Non-ferrous mining in Minnesota will continue those same high standards of environmental protection and worker safety. Minnesota is ready to launch into another 130 years of safely mining non-ferrous critical minerals.

Included in the withdrawal area is the Twin Metals Minnesota resource area and some of the auxiliary lands necessary to the development of that resource. In 2019, Twin Metals submitted a Mine Plan of Operations to the U.S. BLM and a Scoping Environmental Assessment Worksheet data submittal to the Minnesota Department of Natural Resources. Submission of these documents began a multi-year review process that included collection of additional baseline data, impact analysis, and multiple opportunities for public input. None of the extensive environmental data submitted by Twin Metals, some of which had been collected for over 10 years, was included in the Environmental Assessment conducted by the USFS. Twin Metals leases should be re-instated, and they deserve the opportunity to continue the environmental review process.

Underground mining, as with the proposed Twin Metals Project, leaves a very small surface footprint. The mines anticipated in the Rainy River watershed along the Duluth Gabbro contact within 10 miles of the BWCA will likely be underground mines, because the depth of the ore is in the range of 1200 to 3000 feet below the surface. Most surface mines in Minnesota do not go below 450 feet. Water from an underground mine 1200 feet below the water table is not going to cause pollution. Any water that is pumped from an underground mine is treated and recycled.

Minnesota underground mining is often erroneously compared to the environmental legacy issues from pre-environmental regulation mining in the mountains of Colorado, Utah, and Idaho. In those examples, the underground mines were far above the water table. Those historical mines were at high elevations and the waters flowing downhill from those mines eventually reached the lower mountain valley rivers (water table) and streams. These underground mining comparisons are not based on facts. A panel of mining and geological engineering experts could help decision makers better understand this issue.

As examples, Minnesota had over 70 underground mine operations, between 1884 and 1967. These underground mines include the Pioneer, Chandler, Zenith, Sibley, and Savoy mines in Ely, MN. These mines were operated from 1888 to 1967. These mines closed before the 1980 Minnesota Reclamation Rules went into effect. These particular mines are also in the Rainy River Watershed very close to the BWCAW. Is the water from these underground mines polluting Ely?

Minnesota has a State Park at the Soudan Mine and offers underground tours to the public. Because of the tours, the mine is pumped and any water that leaves this mine is treated before it is recycled. Why is this OK?

Legacy mine pits that have filled with water on the Mesabi Iron Range are the public drinking water sources for many communities, such as Chisholm, Virginia, Biwabik, Aurora, and Hoyt Lakes. People don't drink unclean water.

The Kawishiwi and South Kawishiwi Rivers flow naturally into the BWCAW. These rivers flow over the mineral rich exposed Duluth Complex gabbro bedrock, boulders, and sediments. This natural erosion includes Copper, Nickel, PGM's and Sulfate that is picked up by water currents and deposited downstream into many of BWCAW lakes. How does the Secretary of the Interior propose to stop this?

The BLM responded to my comment in the Scoping Comment Disposition of the EA that *"It is relevant to look at other mining operations when assessing risk. The analysis in the Environmental Assessment and resource reports looks at modern engineering mining designs. See also case studies report."* Representative Betty McCollum has repeatedly stated that 93% of copper, nickel mines fail. She says there is no safe mine operating anywhere. But the USFS EA Case Studies Report itself reveals something much different:

> The EA Case Studies Report reviews 20 case studies of worldwide mining projects with similar characteristics to those that may be proposed within the Rainy River Watershed withdrawal area. It summarizes that 16 out of 20 case studies had noncompliance actions, however the number, type and severity varied widely.
>
> Upon review, the report shows that 1 out of the 20 case studies had any significant, environmental-related issues in recent history (Mount Polley, Canada). And of the 10 case studies most similar geographically to the Rainy River Watershed, NONE have had any environmental violations, outside of a few minor remediated issues. So, the Case Studies Report, while giving a vague and misleading summary, contains ample evidence that mining can be done in environments like the Rainy River Watershed without major environmental impacts.

When mineral owners lose their long-term mineral leases with exploration and mining companies as a result of this withdrawal, it is essentially a "taking" by the Federal government (see the "Takings Clause" of the 5th Amendment of the U.S. Constitution). While this withdrawal is aimed at federal lands, State and private lands are mixed together (like a checkerboard or mosaic) with the withdrawal lands. This makes mining in this manner impractical, uneconomic, and wasteful of the resource.

While the mineral withdrawal does not prohibit activity on private and State lands and minerals, mining operations require a contiguous area of land. No developers will contend with a patchwork of ownership wherein they are unable to operate on several of the parcels. It will not be possible to develop these state and private minerals, and this will result in the loss of billions of royalty revenue dollars to private and State mineral lease holders. This also robs the State of Minnesota of billions of dollars in investment. That money will instead be invested elsewhere, profiting other countries, such as China.

The lands within the BWCAW and the bordering Mining Protection Area are already mining exclusion areas. The environmental protections for the BWCA have long been studied and deemed adequate by the environmental community, Federal, State and local government agencies, and the mineral exploration and non-ferrous mining industry. The "roadless area" boundary established in 1948 already considered the nonferrous minerals previously found along the Spruce Road. In the U.S. Congress, this area was exempted out in the 1978 BWCA Wilderness Act by compromise, because of the valuable mineralization found along the "Duluth Gabbro" contact.

A sincere Thank You to Representative Stauber and his team for working diligently to undo an obviously politically motivated and disastrous withdrawal of strategic mineral resources in Minnesota.

Sincerely,

DAVID MEINEKE,
President & CEO

Statement for the Record

National Mining Association

on H. Con. Res. 34 and
H.R. 3195, "Superior National Forest Restoration Act"

The National Mining Association (NMA) supports the concurrent resolution expressing disapproval of the Department of the Interior's (DOI) January 26, 2023, withdrawal of more than 225,000 acres (88 FR 6308) of highly mineralized lands in Northern Minnesota and the Superior National Forest Restoration Act being considered at today's Subcommittee on Energy and Mineral Resources hearing. Ensuring access to our federal lands for responsible mineral exploration and development is critical to supplying the essential materials necessary for nearly every sector of our economy.

Northern Minnesota is a place of tremendous natural beauty and is also blessed with worldclass mineral deposits containing copper, nickel and essential metals that are vital for U.S. economic and national security priorities. In fact, this area contains the largest undeveloped deposits of nickel, copper and platinum metals in the world. Despite these abundant resources, the U.S. continues to be increasingly reliant on foreign sources of metals and minerals, including from geopolitical adversaries that do not share our values when it comes to environmental, labor and safety standards.

The Biden administration's self-sabotage of domestic mineral supply chains through mineral withdrawals is completely out of step with the dramatic increase in minerals production that is needed in the coming decades to keep up with new technologies, infrastructure and manufacturing needs, let alone the administration's energy transition goals. Instead of ceding our nation's mineral supply chain security to other countries, the U.S. should utilize its world-class environmental standards to ensure we need not choose between mining and environmental protection.

Today's legislation supports responsible mineral exploration and development in an area specifically designated and set aside by Congress and the U.S. Forest Service for such activities. The administration's actions continue a dangerous trend of politicizing domestic mineral supply chains first initiated in the waning days of the Obama administration. Continuing to pursue dangerous policies that lock up federal lands with high mineral potential will both sterilize future mineral development in this region, and deny the hard-working men and women of Northern Minnesota the opportunity of high-paying jobs—all, while erasing significant revenues to Minnesota's rural communities that come from these projects in the form of taxes and royalties that support schools and regional development projects.

Currently, less than half of the mineral needs of U.S. manufacturing are met by domestically mined minerals. Today's legislation will help change this alarming trajectory by ensuring access to our nation's vast mineral endowment.

The NMA urges continued trust of our nation's strong environmental regulations and system of due process to strengthen a reliable and stable domestic mineral supply chain for the future.

Local View: Acid rock drainage a nonissue with Twin Metals mine

Duluth News Tribune, January 14, 2022 by Rens Verburg

https://www.duluthnewstribune.com/opinion/columns/local-view-acid-rock-drainage-a-nonissue-with-twin-metals-mine

*****

If you read media coverage about copper-nickel mining, it's likely you've seen references to one of its concerns: the potential for acid rock drainage. This is something the mining industry takes very seriously. Yet, understanding it requires a deeper dive than the oversimplified assumptions we too often read about.

If acid rock drainage concerns you, I urge you to read on. As an expert on this topic, I believe it's critical to better understand this issue and how it may or may not apply to local mining projects.

So, how is acid rock drainage created? Some rock naturally contains sulfide minerals. Sulfides are made up of sulfur bound to another metal, such as iron, copper, or nickel. When oxidation of sulfide minerals occurs naturally or from mining, water that comes in contact with the rock may then contain higher levels of acidity. If not managed properly, this water can affect natural waters, resulting in potentially negative impacts.

Mining-related acid rock drainage may occur when improper or insufficient mitigation measures are in place for two materials: waste rock and tailings. Waste rock is any low-grade or undesirable rock removed during operations. Tailings are the leftover ground materials after the minerals of economic interest have been physically separated and removed from the ore.

In open-pit mining, several tons of waste rock are typically removed for every ton of ore. This waste rock is placed in piles, often around the open pit, and may contain elevated sulfide minerals, which could cause acid rock drainage if not managed properly. However, modern open-pit mines employ environmentally protective management plans for waste rock and are strictly regulated by U.S. government agencies.

With underground mining, such as the proposed Twin Metals Minnesota copper-nickel-cobalt project, tunnels are created to strategically target the ore deep underground. The underground mining method does not require excavation and movement of equally large amounts of waste rock, and no surface waste rock piles are needed. Therefore, the risk of acid rock drainage from surface facilities is zero.

As mentioned, tailings are a second potential source of acid rock drainage. It's important to understand that every mineral deposit's geology varies greatly, and a mine must tailor its mineral-processing methods based on these variations and the target minerals it's after. The processing step at a mine involves separating target minerals from the ore, resulting in a concentrate product that is sold. The leftover materials are the tailings, and, if they have a sufficient sulfide content, they can present acid-rock-drainage issues if unmanaged. Therefore, such tailings must be managed safely to ensure acid rock drainage does not occur.

The geology of the Twin Metals deposit is such that the target metals, copper and nickel, occur in the predominant sulfide minerals in the deposit. This is an important qualifier, because it means that during processing, these minerals are recovered and report to the concentrates. The financial success of the mining operation depends on the recovery of the sulfides. As a consequence, the leftover tailings do not contain enough sulfide minerals to create acid, so the risk of acid rock drainage from this potential source is zero.

So, acid rock drainage simply has little or no relevance to the Twin Metals project. Furthermore, Twin Metals has a host of innovations that set the project apart as a model operation, such as the environmentally friendly dry stack tailings method, carbon sequestration, an electric fleet, and a goal to become net zero.

Each of us consumes metals every day. As such, I encourage us all to dig deeper into the science behind our modern mining industry that produces the materials on which we are dependent.

Mr. STAUBER. If there is no further business, without objection, the Committee stands adjourned.

[Whereupon, at 11:56 a.m., the Subcommittee was adjourned.]

[ADDITIONAL MATERIALS SUBMITTED FOR THE RECORD]

Submissions for the Record by Rep. Stauber

Up North Jobs Petitions and Names

Petition to U.S. Secretary of the Interior Deb Haaland and the Biden Admin

In opposition to the U.S. Forest Services' and the BLM's plan to ban mining on 225,328 acres of land in the Superior National Forest for 20 years, where mining is a permitted activity.

302 signatures

H. Con. Res. 34

Support E-mails sent to Rep. Staubers office

Dear Mr. Morley:

I support the upcoming draft legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. It's unfair that the federal government can simply take away our rights and I do not support it at all. I do not want to be beholden to countries like China for our basic everyday needs. What's scarier yet is national security. Do you realize what could happen if we were declared war on! Please share my support for the removal of the mining moratorium with the powers that be.

Thank you.

Susan and Rudy Scufsa
Winton, MN

****

Dear Andrew:

Please include my support the upcoming draft legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. The continued usurping of rights by the federal government must be stopped. Please share my support for the removal of the mining moratorium with all involved.

Thank you.

Mike Forsman
Ely, MN

On a separate note, how is the idea of the tribes being given co-stewardship of the 3.3 million acres of Superior National Forest without any public comment, notification, or legislation legal? Thanks again. Mike

****

Dear Mr. Morley:

To the benefit of our national security and our own Iron Range economic well-being I support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres.

It is imperative that we get our house in order to meet possible future defense needs plus consumer needs in future green development without aiding our country's enemies. We have the minerals, plus modern mining technologies to cleanly mine our way into a more secure future for all Americans.

Thank you.

****

Dear Mr. Morley:

To the benefit of our national security and our own Iron Range economic well-being I support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres.

It is imperative that we get our house in order to meet possible future defense needs plus consumer needs in future green development without aiding our country's enemies. We have the minerals, plus modern mining technologies to cleanly mine our way into a more secure future for all Americans.

Thank you.

Bridget Marsh
Chisholm, MN

****

Dear Mr. Morley:

I support the upcoming draft legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. It's unfair that the federal government can simply take away our rights are I do not support it at all. Please share my support for the removal of the mining moratorium with the powers that be.

Thank you.

Bridget Marsh
Chisholm, MN

****

Dear Mr. Morley:

I want to bring to your awareness of my support for benefit of our national security and our own Iron Range economic well-being I support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres.

It is imperative that we get our house in order to meet possible future defense needs plus consumer needs in future green development without aiding our country's enemies. We have the minerals, plus modern mining technologies to cleanly mine our way into a more secure future for all Americans.

Thank you for your time.

Ken Hegman

****

Dear Mr. Morley:

In light of our country's dwindling national security with respect to our poor supplies of important minerals plus Minnesota Iron Range economic stability, I support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres.

As a nation, we need to be serious about matters such as this which could leave our country defenseless during emergencies. There is no excuse for stopping mining and mineral exploration in the United States only to then rely upon our enemies for much needed materials.

It's about economic and national security. Mining has been a way of life in Northern Minnesota for over a century and we still have the cleanest water in the state and throughout the country. Stop relying on China or 3rd world countries that use and abuse child labor laws and environmental laws.

Thank you.

David Herring

****

Dear Mr. Morley:

To the benefit of our national security and our own Iron Range economic well-being I support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5,000 acres.

It is imperative that we get our house in order to meet possible future defense needs plus consumer needs in future green development without aiding our country's enemies. We have the minerals, plus modern mining technologies to cleanly mine our way into a more secure future for all Americans.

Thank you.

Katherine Sedgeman

****

Dear Mr. Morley:

I support the upcoming draft legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. It's unfair that the federal government can simply take away our rights are I do not support it at all. Please share my support for the removal of the mining moratorium with the powers that be.

Thank you.

Bridget Marsh
Chisholm, MN

****

Dear Mr. Morley:

I completely support HCR 34, which uses the provision enshrined in Section 204(c) of the Federal Lands Policy and Management Act, that allows the House and Senate to disapprove of mineral withdrawals over 5000 acres.

Please consider how far mining has come, especially with regards to safety and the environment. The nation as a whole needs these minerals, and the people of the Iron Range of MN have been mining for over 150 years and know how to mine cleanly and safely. We don't need to rely on our enemies for our much needed minerals. Let's mine here and let's mine now.

Thank you.

Elizabeth Eloranta
Tower, MN

****

Dear Mr. Morley:

I support the upcoming legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. For national security, and Iron Range economic stability through minerals diversity, Congressman Stauber is on the right track.

Joe Baltich
Ely, MN

****

Dear Mr. Morley:

I live in Ely, MN and strongly support mineral exploration and extraction (mining) in our region, including the Superior National forest. Mining has been going on in our region for over 100 years and we have some of the cleanest water & air of any region in our Nation!

Modern mining & reclamation methods are far superior to the past along with strict environmental regulations that would assure adherence to the highest standards. The proposed Twin Metals mine is deep under ground, well below the water table. A large percentage of tailings would be returned back underground for fill, the remaining would be dry stacked away from the Mine entrance. Again, this a superior method as opposed to tailing ponds that can leach.

The independence & prosperity of our Nation is enhanced when we mine & extract our own energy and mineral sources. Our region is in great need of high paying jobs for working families; the Twin Metals and other mining operations would be a great economic boom for our region! This coupled with the fact that our environmental & labor regulations are better than any other place in the World, makes mining in Northeast Minnesota a tremendous asset to the USA and the World!

I strongly support HCR 34 and oppose the 20 year mining moratorium imposed by the Biden administration and urge an immediate reversal.

Sincerely,

Mark Blanchfield
Ely, MN

****

Dear Mr. Morley:

I support the upcoming draft legislation that would undo the mineral withdrawal and reinstate the long-standing mining leases that were ripped away as part of the 20-year ban. It's unfair that the federal government can simply take away our rights! And support China as a result! Please share my support for the removal of the mining moratorium with the powers that be.

Thank you.

Linda J. Graeter, PhD

****

I oppose the 20 year mining ban.

Ms. Jane M. Hosking
Duluth, MN

Submissions for the Record by Rep. Grijalva

Statement for the Record

U.S. Department of the Interior

on H. Con. Res. 34
May 11, 2023

Thank you for the opportunity to provide this Statement for the Record on H. Con. Res. 34, *Expressing disapproval of the withdrawal by the Secretary of the Interior of approximately 225,504 acres of National Forest System lands in Cook, Lake, and Saint Louis Counties, Minnesota, from disposition under the United States mineral and geothermal leasing laws, subject to valid existing rights.*

The resolution seeks to terminate Public Land Order (PLO) 7917, withdrawing certain National Forest System lands from operation of the mineral and geothermal leasing laws under section 204(c) of the Federal Land Policy and Management Act (FLPMA). PLO 7917 is necessary to protect the Boundary Waters Canoe Area Wilderness, the surrounding watershed, wildlife, Tribal and treaty rights, and robust recreation economy of northern Minnesota. The Department of the Interior (DOI) strongly opposes any action to reverse the locally driven efforts to protect and conserve this critically important and fragile landscape. Furthermore, the resolution cannot terminate the withdrawal established by PLO 7917, as the resolution relies upon an unconstitutional provision in section 204(c) of FLPMA. The resolution can therefore have no effect on the validity of the PLO.

Background

The Bureau of Land Management (BLM) manages approximately 245 million surface acres, located primarily in 12 western states, as well as 30 percent of the nation's onshore mineral resources across 700 million subsurface acres, overlain by properties managed by other Federal agencies, such as the Department of Defense and the United States Forest Service, as well as state and private lands. Section 204 of FLPMA authorizes the Secretary of the Interior to make, modify, extend, or revoke most withdrawals on Federal lands, including withdrawals from the operation of mineral leasing and mining laws. Under FLPMA, the surface managing agency may apply to the Secretary of the Interior for a withdrawal.

On September 29, 2021, the Forest Service submitted a withdrawal application to the BLM requesting that the Secretary of the Interior withdraw approximately 225,504 acres of Forest Service-managed lands in the Superior National Forest from disposition under the mineral and geothermal leasing laws for a 20-year period, subject to valid existing rights. The BLM published a notice in the Federal Register on October 21, 2021, announcing its receipt of the Forest Service's application, initiating a two-year segregation of the lands from disposal under the mineral and geothermal leasing laws, commencing a 90-day comment period, and announcing that the agencies would hold public meetings regarding the withdrawal application.

Secretary Haaland signed PLO 7917 on January 26, 2023, withdrawing approximately 225,504 acres from disposition under the U.S. mineral and geothermal leasing laws for a period of 20 years, subject to valid existing rights. This action was the culmination of extensive evaluation by Federal partners and robust public involvement regarding the potential impacts of mining on the important natural and cultural resources of the Rainy River watershed.

The purpose of the withdrawal is to protect and preserve natural and cultural resources in the Rainy River watershed, including the Boundary Waters Canoe Area Wilderness, the Boundary Waters Canoe Area Mining Protection Area, and the 1854 Ceded Territory, in a holistic manner from the known and potential adverse environmental impacts arising from mineral exploration and development. The Boundary Waters Canoe Area Wilderness and the surrounding watershed are a spectacular network of rivers, lakes, and forests that comprise the most heavily visited wilderness area in the United States. More than 150,000 visitors from around the world are drawn annually to the 1.1-million-acre Boundary Waters. The area contains over 1,100 lakes interspersed with islands and surrounded by forests that extend nearly 150 miles along the border with Canada. The Boundary Waters boasts more than 1,200 miles of canoe routes, 12 hiking trails, and 2,000 designated campsites, and it contributes up to $17.4 million annually to the more than $540 million recreation and tourism economies in Cook, Lake, and St. Louis Counties.

H. Con. Res. 34

H. Con. Res. 34 seeks to invalidate the withdrawal established by PLO 7917 under the legislative disapproval provision of section 204(c) of FLPMA, which provides that a withdrawal over 5,000 acres shall terminate and become ineffective if Congress adopts a concurrent resolution stating that it does not approve of the withdrawal. This provision contains additional procedures for Congressional approval and does not require the resolution to be presented to the President for approval following passage by Congress.

Analysis

The Department strongly opposes H. Con. Res. 34 and any efforts to roll back the protections of this sensitive and irreplaceable area from the adverse impacts of new mineral and geothermal exploration and development. The 20-year withdrawal, which was made in accordance with the authority in section 204 of FLPMA, is critically needed to protect and preserve the fragile and vital social and natural resources, ecological integrity, and wilderness values in the Rainy River watershed and the Boundary Waters Canoe Area Wilderness. The withdrawal builds upon years of locally led conservation efforts to protect the landscape, watershed, and the outdoor recreation economy they support. A detailed description of the rationale underlying the recommendation and decision to withdraw the lands is contained in the BLM's decision memorandum for the withdrawal, which was signed by Secretary Haaland on January 26, 2023.

As noted above, H. Con. Res. 34 relies on the legislative disapproval provision in section 204(c) of FLPMA. That provision is unconstitutional under long-standing Supreme Court caselaw holding that Congress cannot invalidate a decision of the Executive Branch absent presentment to the President. (*INS v. Chadha*, 462 U.S. 919 (1983)). In *Chadha*, the Supreme Court held that a provision that allows Congress to take action that is "essentially legislative in purpose and effect" without approval by the President violates the presentment requirements of Article I of the United States Constitution. The Court explained that once Congress delegates authority to the executive branch, Congress must abide by that delegation until it is legislatively altered or revoked in accordance with the bicameral and presentment requirements of the Constitution. The United States Court of Appeals for the Ninth Circuit has directly applied the Supreme Court's decision to Section 204(c) of FLPMA and concluded that the legislative disapproval provision that H. Con. Res. 34 relies on is unconstitutional (*National Mining Association v. Zinke*, 877 F.3d 845 (9th Cir. 2017)).

For this reason, any resolutions passed pursuant to that authority would have no effect on withdrawals that are validly established by the Secretary of the Interior. Even if approved, the resolution would not terminate PLO 7917, and the approximately 225,504 acres of National Forest System lands in Cook, Lake, and Saint Louis Counties, Minnesota, that are subject to PLO 7917 would remain withdrawn from disposition under the United States mineral and geothermal leasing laws, subject to valid existing rights.

Conclusion

Thank you for the opportunity to provide this statement for the record.

Submissions for the Record by Rep. Ocasio-Cortez

Minnesota Power looks to ratepayers to recover mine and mill losses

Verso and Keetac closures equated to losing all residential business at once.

Star Tribune, November 10, 2020 by Brooks Johnson

https://www.startribune.com/minnesota-power-looks-to-ratepayers-to-recover-mine-and-mill-losses/573027571/

*****

DULUTH—With two major industrial customers offline most of this year, Minnesota Power will likely be asking state regulators to approve a rate increase to cover its lost revenue next year—even as its parent company Monday reported a 30% third-quarter profit jump to $40.7 million driven largely by a recent rate increase.

The Duluth-based utility has filed a petition with the state Public Utilities Commission asking to track missed revenue from the indefinitely closed Verso paper mill in Duluth and the Keewatin Taconite plant that closed this spring and will reopen in mid-December.

"The loss of these two customers to Minnesota Power has been the equivalent of losing its entire residential customer class in the course of a few months," the company wrote in its filing. Combined, the mill and the mine were projected to comprise about 12% of total electricity sales this year, or about $30 million annually. "In order to account for that revenue deficiency, Minnesota Power will likely need to file a general rate case as early as March 1, 2021."

Though it has about 145,000 customers across a wide swath of northeastern and central Minnesota, 74% of Minnesota Power's electricity sales are to a handful of taconite mines and paper mills. Several mines were temporarily shut down this spring and summer, but by the end of the year all Iron Range operations will be operating again after a rebound in global steel markets.

During a call with investors Monday morning, leaders of parent company Allete Inc. outlined the request to track and recover the losses.

"Minnesota Power proposed to defer any lost revenues to its next general rate case or other proceeding . . . and anticipates filing a general rate case in November 2021," said Chief Accounting Officer Steve Morris.

The average monthly residential bill rose $3.53 earlier this year as part of a rate increase settlement reached this spring.

Parent company Allete recorded a 2% increase in revenue to $293.9 million compared to the third quarter of 2019.

Despite strong earnings gains in the quarter, the company said it expects earnings per share to be down $0.15 through the end of the year due to the pandemic.

"We contemplated the potential of a second wave of the COVID-19 pandemic. This risk appears now to be a reality," Allete CEO Bethany Owen said. "The incoming President-Elect is assembling a coalition . . . for how we turn this second wave around. We believe there is hope and really strong progress."

On a strong day for the stock market following promising news for a possible coronavirus vaccine, Allete's stock price shot up nearly 7.6% Monday to close at $57.87. After starting the year trading above $83 per share, Allete's share price briefly rose above $60 for the first time since March on Monday.

Visuals Shown During the Hearing by Rep. Fulcher

U.S. Net Import Reliance from USGS

Figure 2.—2022 U.S. Net Import Reliance[1]

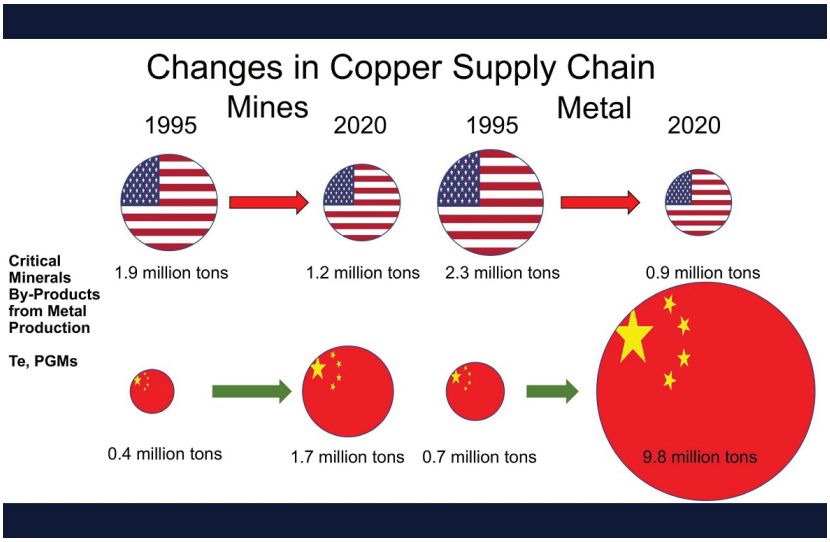
Commodity	Net import reliance as a percentage of apparent consumption	Major import sources (2018–21)[2]
ARSENIC, all forms	100	China, Morocco, Belgium
ASBESTOS	100	Brazil, Russia
CESIUM	100	Germany
FLUORSPAR	100	Mexico, Vietnam, South Africa, Canada
GALLIUM	100	China, Germany, Japan, Ukraine
GRAPHITE (NATURAL)	100	China, Mexico, Canada, Madagascar
INDIUM	100	Republic of Korea, Canada, China, France
MANGANESE	100	Gabon, South Africa, Australia, Georgia
MICA (NATURAL), sheet	100	China, Brazil, Belgium, Austria
NIOBIUM (COLUMBIUM)	100	Brazil, Canada
RUBIDIUM	100	Germany
SCANDIUM	100	Europe, China, Japan, Philippines
STRONTIUM	100	Mexico, Germany, China
TANTALUM	100	China, Germany, Australia, Indonesia
YTTRIUM	100	China, Germany, Republic of Korea, Japan
GEMSTONES	99	India, Israel, Belgium, South Africa
BISMUTH	96	China, Republic of Korea, Mexico, Belgium
NEPHELINE SYENITE	>95	Canada
RARE EARTHS,[3] compounds and metals	>95	China, Malaysia, Estonia, Japan
TITANIUM, sponge metal	>95	Japan, Kazakhstan, Ukraine
POTASH	94	Canada, Russia, Belarus
DIAMOND (INDUSTRIAL), stones	89	South Africa, Congo (Kinshasa), India, Sierra Leone
IRON OXIDE PIGMENTS, natural and synthetic	87	China, Germany, Brazil, Canada
ANTIMONY, metal and oxide	83	China, Belgium, India
CHROMIUM, all forms	83	South Africa, Kazakhstan, Russia, Germany
STONE (DIMENSION)	82	Brazil, China, Italy, India
PEAT	81	Canada
TITANIUM MINERAL CONCENTRATES	81	South Africa, Australia, Madagascar, Canada
ABRASIVES, silicon carbide	79	China, Brazil, Netherlands, South Africa
TIN, refined	77	Peru, Indonesia, Bolivia, Malaysia
COBALT	76	Norway, Canada, Finland, Japan
ZINC, refined	76	Canada, Mexico, Peru, Spain
ABRASIVES, fused aluminum oxide	>75	China, Canada, Brazil, Austria
BARITE	>75	China, India, Morocco, Mexico
BAUXITE	>75	Jamaica, Brazil, Guyana, Turkey
TELLURIUM	>75	Canada, Germany, China, Philippines
GARNET (INDUSTRIAL)	69	South Africa, China, India, Australia
RHENIUM	69	Chile, Canada, Germany, Kazakhstan
SILVER	69	Mexico, Canada, Poland, Chile
PLATINUM	66	South Africa, Germany, Switzerland, Italy
DIAMOND (INDUSTRIAL), bort, grit, dust, and powder	62	China, Republic of Korea, Ireland, Russia
ALUMINA	59	Brazil, Australia, Jamaica, Canada
NICKEL	56	Canada, Norway, Australia, Finland
ALUMINUM	54	Canada, United Arab Emirates, Russia, China
VANADIUM	54	Canada, China, Brazil, South Africa
MAGNESIUM COMPOUNDS	53	China, Israel, Canada, Brazil
GERMANIUM	>50	China, Belgium, Germany, Russia
IODINE	>50	Chile, Japan
MAGNESIUM METAL	>50	Canada, Israel, Mexico, Taiwan
SELENIUM	>50	Philippines, Mexico, Germany, China
TUNGSTEN	>50	China, Germany, Bolivia, Vietnam
ZIRCONIUM, ores and concentrates	<50	South Africa, Senegal, Australia, Russia
SILICON, metal and ferrosilicon	45	Russia, Brazil, Canada, Norway
LEAD, refined	42	Canada, Mexico, Republic of Korea
COPPER, refined	41	Chile, Canada, Mexico
FELDSPAR	39	Turkey, Mexico
SALT	29	Chile, Canada, Mexico, Egypt
PERLITE	28	Greece, China, Mexico
PALLADIUM	26	Russia, South Africa, Italy, Germany
LITHIUM	>25	Argentina, Chile, China, Russia
BROMINE	<25	Israel, Jordan, China
CADMIUM, unwrought	<25	Australia, Germany, China, Peru
MICA (NATURAL), scrap and flake	24	Canada, China, India, Finland
CEMENT	21	Canada, Turkey, Greece, Mexico
VERMICULITE	20	South Africa, Brazil

[1]Not all mineral commodities covered in this publication are listed here. Those not shown include mineral commodities for which the United States is a net exporter (abrasives, metallic; boron; clays; diatomite; gold; helium; iron and steel scrap; iron ore; kyanite; molybdenum; rare earths, mineral concentrates; sand and gravel, industrial; soda ash; titanium dioxide pigment; wollastonite; zeolites; and zinc, ores and concentrates) or less than 20% net import reliant (beryllium; gypsum; iron and steel; iron and steel slag; lime; nitrogen (fixed)—ammonia; phosphate rock; pumice and pumicite; sand and gravel, construction; stone, crushed; sulfur; and talc and pyrophyllite). For some mineral commodities (hafnium; mercury; quartz crystal, industrial; thallium; and thorium), not enough information is available to calculate the exact percentage of import reliance.

[2]Listed in descending order of import share.

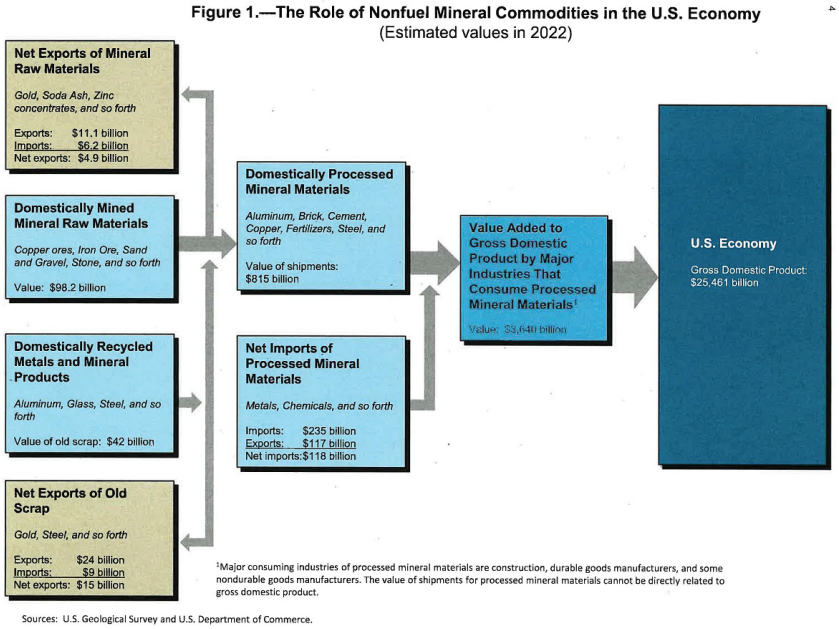
[3]Data include lanthanides.

China Copper Supply Chain



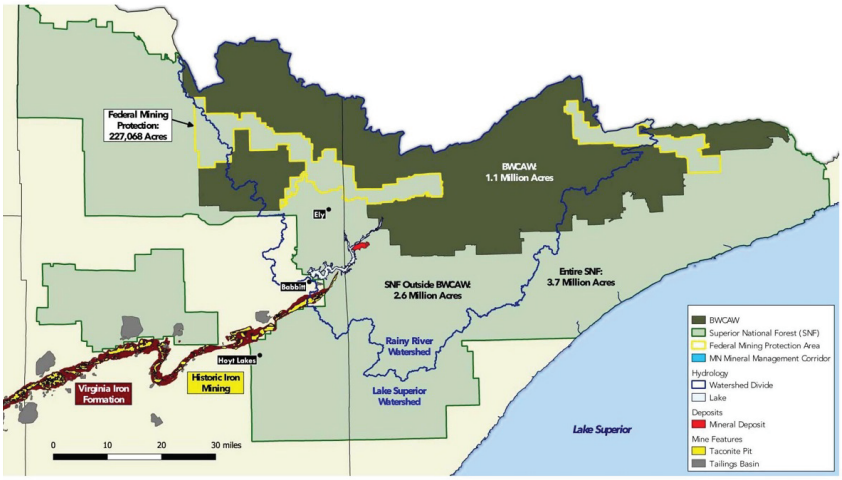
Visual Shown During the Hearing by Rep. Westerman

The Role of Nonfuel Mineral Commodities in the USA



Visuals Shown During the Hearing by Rep. Duarte

Map of Forest Watershed and Mineral Deposit



Boundary Waters Aerial Photo

Visual Shown During the Hearing by Rep. Gosar

Canadian Map of Boundary Waters