

Special Report 79

# ALASKA'S MINERAL INDUSTRY 2022



State of Alaska  
Department of Natural Resources  
Division of Geological & Geophysical Surveys



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# Alaska's Mineral Industry 2022

David J. Szumigala<sup>1</sup>

**Cover.** Reverse circulation drilling at the Venus Prospect on the East Wiseman claim block. The property is held by Wiseman Metals in partnership with Doyon Ltd. Photo provided by Wiseman Metals.

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<sup>1</sup>Alaska Division of Geological & Geophysical Surveys, 3354 College Rd., Fairbanks, Alaska 99709-3707.

# EXECUTIVE SUMMARY

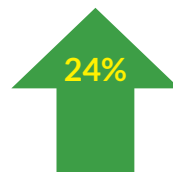
Exploration  
Expenditures



Development  
Expenditures



Estimated  
Revenue to Industry



This summary of the status of Alaska's mineral industry for 2022 is the 42nd such annual report produced by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS). Published for almost half of a century, the annual report endeavors to provide a consistent and factual snapshot of mineral industry activity in Alaska. It also serves as the authoritative historical record of mining in the State of Alaska.

The reported value of Alaska's mineral industry in 2022 totaled \$4.29 billion, a 24 percent increase from 2021. The total value for 2022 is a composite of the year's expenditures on exploration and development, plus the revenue to the operators/owners from the produced mineral commodities.

Alaska's mining industry continued to recover from the negative effects of the COVID-19 pandemic. COVID management protocols and quarantine measures still impacted all projects, but adaptations made in 2020, the availability of vaccines and significantly lower COVID-19 rates in Alaska, allowed projects to carry forward in 2022. Staffing challenges and supply chain limitations continued through 2022. Metal prices were mixed compared to 2021, but increasing gold prices improved cashflow for Alaska's precious metal mines.

Government revenue from Alaska's mineral industry totaled \$189.8 million in 2022 compared to \$97.6 million in 2021. Tax payments to local governments totaled \$52

million in 2022. Mining companies paid the largest share of local taxes in the Northwest Arctic Borough, Fairbanks North Star Borough, Denali Borough, and City & Borough of Juneau.

The USGS estimated that the value of nonfuel mineral production in Alaska for 2022 was \$4.51 billion, ranking 6<sup>th</sup> among the 50 States and accounting for 4.59 percent of the United States total mineral production in 2022. The estimated revenue to Alaska's mineral industry for nonfuel mineral production for 2022 was \$3.78 billion. This estimated revenue value accounts for actual sale prices and includes smelting, refining, and transportation costs.

Zinc continued to be the top metal produced in 2022, accounting for 52 percent of Alaska's total metal production value. Gold followed at 33 percent of total production value, with total ounces produced up more than 2 percent. Estimated silver production dropped by almost 1 million ounces, while lead production dropped by approximately 20,000 tons.

Development expenditures in Alaska increased 15 percent to \$391.0 million in 2022. Projects and capital expenditures delayed in 2020 due to the pandemic were advanced with strong mitigation measures. Currently, only capital expenditures at Alaska's operating mines are contributing to this category, which is sensitive to the timing of high-cost individual projects.

Mineral exploration expenditures rose to \$305.8 million, in line with global trends, and a 12 percent increase from 2021 spending

levels. Alaska's remote, summer-season exploration projects posted a strong rebound from disruptions and uncertainty in 2020 and 2021 associated with the COVID-19 pandemic. Exploration spending on gold projects totaled \$162 million dollars in 2022 and represented 53 percent of total mineral exploration expenditures.

In 2022, 71 lode mineral exploration projects, some managed by the same company, reported activity. Excluding Alaska's operating mines, 31 projects spent \$1 million or more on exploration. An additional 25 projects each spent \$100,000 or more. The Southwest Region saw the most exploration.

Active mining claims and prospecting sites covered more than 4.7 million acres of Alaska in 2022, an increase of 10 percent from 2021. State of Alaska mining claims, which account for 97 percent of the total land claimed, increased by 10 percent, while the total area of Federal mining claims decreased by 1 percent in 2022.

Mineral industry employment increased modestly across most sectors in 2022, up

almost 5 percent to an estimated 3,867 full-time-equivalent jobs. The steepest increase in employment was tied to increased mineral exploration activity, and employment at Alaska's operating mines also increased significantly.

Estimated revenues to the State of Alaska and municipalities from mineral-industry-specific fees, rents, sales, royalties, and taxes amounted to more than \$189.8 million in 2022, a \$93 million increase from 2021 revenues.

Twenty-three companies publicly reported drilling programs in Alaska in 2022. Total drilling, including both publicly reported and confidential drilling footages, decreased 14 percent to 1,932,491 feet. Development, and production drilling totaled 1,858,047 feet. Twenty-five individual projects reported 842,801 feet of exploration drilling in 2022, a decrease from thirty-three projects in 2021, as well as a 5 percent decrease in footage drilled. Reverse circulation (rotary) drilling totaled 71,655 feet in 2022. This is a 24 percent decrease from the 2021 reported hardrock rotary footage total.

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# INTRODUCTION

This summary of the status of Alaska’s mineral industry for 2022 is the 42nd such annual report produced by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGs). The authors of this annual report aim to provide a consistent and factual snapshot of mineral industry activity in Alaska. This report serves as the authoritative historical record of mining in the State of Alaska, which is vital for informed decision-making by State and local governments, the Legislature, land managers, industry, Native corporations, and the public.

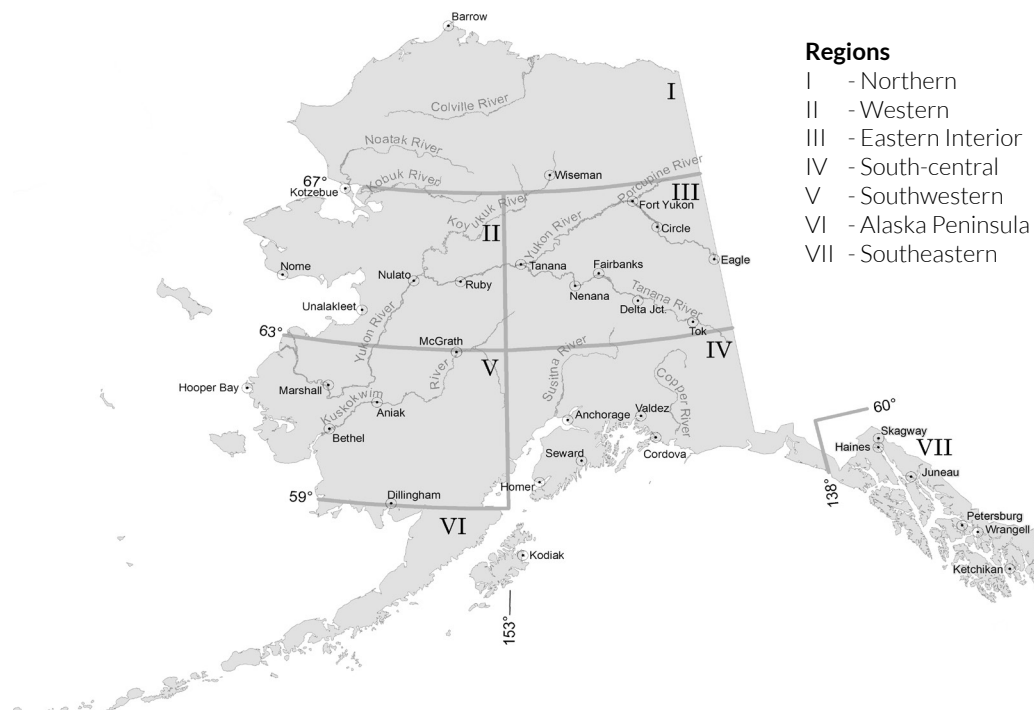
Alaska has long been considered a frontier compared to most of North America. Its natural resources are substantial but vastly underexplored. Alaska’s mineral endowment is evident from its historically significant production: placer gold from the Fairbanks and Nome mining districts, copper from the Kennecott area, lode gold from

the Alaska–Juneau (A–J) and Treadwell mines near Juneau, and placer platinum from the Goodnews Bay Mining District. Alaska’s mineral wealth is shown by major deposits currently in production that include Red Dog, Greens Creek, Pogo, Fort Knox, Kensington, and Usibelli Coal mines (photo 1). The Dawson Mine in southeast Alaska is a small volume gold producer. Alaska added the Manh Choh Mine, near Tok in eastern Alaska, as an additional operating gold mine in 2022.

Future domestic sources of critical raw materials needed for 21<sup>st</sup> century technologies are present throughout Alaska. Promising advanced-exploration and permitting-phase projects include Donlin Gold, Pebble, Livengood, Estelle, Niblack, Palmer, Arctic, Bornite, Whistler and Anjarraaq–Aktigiruaq deposits. These projects and others, found throughout Alaska’s 7 geographic regions defined for this report (fig. 1), collectively



**Photo 1.** Ace In the Hole dragline working at Usibelli Coal Mine. Photo provided by Usibelli Coal Mine Inc.



**Figure 1.** Regions of mineral activity as described in this report.

represent a significant proportion of the United States' domestic gold, silver, copper, and base-metal resources. These deposits demonstrate that there are still extremely large mineral deposits to be developed in Alaska. Significant resources of other commodities include the advanced-exploration projects at Graphite Creek (graphite deposit) and Bokan Mountain (rare-earth-element deposit).

Following the impacts of COVID-19, challenges in 2022 included slowing economic growth and rising inflation. Despite these challenges, gold and silver prices stayed relatively stable, unlike declines in other investment classes.

Without a doubt, Alaska holds other world-class mineral deposits yet to be discovered. In 2022, the Fraser Institute annual survey of mining companies ranked Alaska 11th out of 62 worldwide jurisdictions for overall investment attractiveness by mining and exploration companies, which considers geologic potential as well as government policy factors that affect exploration investment. Alaska also ranked 4th

for taxation regime. Alaska ranked poorly due to uncertainty regarding land claim disputes, protected areas, and quality of infrastructure, and ranked moderately in availability of skilled labor.

Alaska ranked 13th for best practices mineral potential (i.e., world class regulatory environment, highly competitive taxation, no political risk or uncertainty, and a fully stable mining regime). Alaska was perceived to have mining-friendly regulatory and fiscal policies, as well as attractive geological databases. Of the survey respondents for Alaska, 67 percent indicated that timelines for permit-approval decisions were met between 80 to 100 percent of the time, the second highest share for all surveyed jurisdictions. Respondents expressed increased concern over the availability of skilled labor, and decreased concerns regarding environmental regulations, regulatory overlap, infrastructure quality, and political stability. Alaska also performed relatively well this year regarding time for permits, with 78 percent of respondents indicating they were able to get necessary permits in less than 6 months. This year, 33 percent of

respondents for Alaska indicated that the time to obtain an approved permit had shortened somewhat over the last 10 years.

It is the policy of the State of Alaska to encourage the settlement of its land and the development of its resources by making them available for maximum use consistent with the public interest. Alaska, in its strategic Pacific Rim location, offers prospective land, security of title, State-sponsored geological and geophysical mapping, a reasonable permitting process coordinated among agencies, a capable workforce, exploration incentives, and innovative infrastructure equity-sharing programs. More than 191 million acres of Federal, State, and Native-owned lands are open for mineral-related activities and mining. The minerals industry has been and continues to be a driving force in the State of Alaska's economy through significant local employment, infrastructure, and government revenue.

Alaska's mining industry, like the rest of the world, continued to be impacted by the lingering effect of the COVID-19 pandemic during 2022. The associated mitigation measures and restrictions, along with quarantine policies and availability of a vaccine continued to add significant expense for companies but allowed projects to go forward. Scarcity of necessary parts and commodities, driven by supply chain issues, and manpower shortages led to increased costs and continued to modify some projects' planned work.

While all operations reported increased productivity, whole-year production levels remained within normal ranges. The effects of the pandemic on the global economy lessened during 2022 and metal prices rose for gold and zinc. Prices dropped for silver and some base metals. Alaskan mine revenue increased significantly by more than 26 percent to 3.59 billion (table 1). Mineral development expenditures in Alaska totaled \$391.0 million in 2022, up 15 percent from \$339.1 million in 2021. Exploration expenditures rose by almost 12 percent to \$305.8

million in 2022. Overall, the value of Alaska's mining industry rose almost 24 percent to an estimated \$4.29 billion.

The exploration, development, and production values used in this report are compiled from past year statements issued by companies, including press releases and corporate annual and financial reports, as well as replies to questionnaires, and news media articles. Government data on employment, government revenue, and mining claims are provided by the Alaska Department of Natural Resources (ADNR) Division of Mining, Land & Water, the Alaska Department of Labor and Workforce Development (DLWD), the Alaska Department of Revenue (DOR), and the U.S. Mine Safety and Health Administration (MSHA). Average metal prices used in the first-market-value calculations that are incorporated into estimated mining revenues and commodity values are based on average daily prices on the London Metal Exchange. Coal prices are estimated from Alaska energy sector prices and available coal heating values. Industrial materials prices are based on regional rates reported by operators and rates reported by the U.S. Geological Survey (USGS) in their annual mineral commodity summaries. Many of the numbers contained in this report are estimates, with commodity values and company revenue estimated from theoretical first market values likely to be overstated, while numbers based on voluntary reporting are likely to be minimum estimates of the value of the mining industry to Alaska's economy.

## EMPLOYMENT

Total mineral industry employment in 2022 is estimated at 3,867 full-time-equivalent jobs, an overall increase of about 177 jobs or almost 5 percent from 2021 (table 2). This is the largest estimated total mineral industry employment since 2013.

The Alaskan mineral exploration sector

gained an estimated 56 jobs, up 12 percent from 2021. The estimated employment increase in exploration projects reflects the sharp rise in 2022 mineral exploration expenditures. Exploration employment was estimated for 22 of 86 lode exploration projects using their reported exploration expenditure in conjunction with cost-per-project ratios averaged from 64 projects with

complete employment data.

Estimated employment in mine development activities increased by 18 jobs in 2022, while mine production employment increased by 103 jobs, a combined increase of 121 positions (3.7 percent). Changes in the number of development jobs may be tied to the cycle of specific large capital projects at Alaska's

**Table 1.** Reported annual exploration and development expenditures of the mineral industry, the estimated theoretical first market value of mineral production in Alaska, and estimated revenue to the mineral industry from the sale of those commodities (in millions of dollars), 1981–2022. Average annual values are given for 1981–1985, 1986–1990, 1991–1995, and 1996–2000; individual year totals are provided for 2001–2022

Year	Exploration Expenditures (\$ millions)	Development Expenditures (\$ millions)	Theoretical First Market Value (\$ millions) <sup>a</sup>	Estimated Revenue to Industry (\$ millions) <sup>b</sup>
1981–1985	\$37.5	\$36.3	\$204.7	–
1986–1990	\$36.2	\$109.6	\$288.6	–
1991–1995	\$33.2	\$55.3	\$520.1	–
1996–2000	\$49.4	\$158.7	\$917.4	–
2001	\$23.8	\$81.2	\$917.3	–
2002	\$26.5	\$34.0	\$1,012.8	–
2003	\$27.6	\$39.1	\$1,000.7	–
2004	\$70.8	\$209.1	\$1,338.7	–
2005	\$103.9	\$347.9	\$1,401.6	–
2006	\$178.9	\$495.7	\$2,858.2	–
2007	\$329.1	\$318.8	\$3,367.0	–
2008	\$347.3	\$396.2	\$2,427.1	–
2009	\$180.0	\$330.8	\$2,455.6	–
2010	\$264.4	\$293.3	\$3,126.8	–
2011	\$365.1	\$271.9 <sup>c</sup>	\$3,507.7	–
2012	\$335.1	\$342.4	\$3,436.1	–
2013	\$175.5	\$358.8	\$3,418.7	–
2014	\$96.2	\$281.7	\$3,282.1	–
2015	\$58.3	\$309.9 <sup>c</sup>	\$2,759.2	–
2016	\$58.9	\$217.4	–	\$2,536.6
2017	\$120.8	\$299.5	–	\$2,724.7
2018	\$140.1	\$334.1	–	\$2,428.1
2019	\$171.0	\$347.8	–	\$2,530.0
2020	\$145.9	\$267.8	–	\$2,790.9
2021	\$273.1	\$339.1	–	\$2,840.0
2022	\$305.8	\$391.0	–	\$3,588.9

Exploration, development, and production figures are provided in Alaska's Mineral Industry reports published annually by DGGs and sister agencies.

<sup>a</sup>Theoretical first market value is calculated by multiplying reported commodity amounts produced for a calendar year by the average yearly price per unit. This figure may significantly overestimate the value of the commodity, because it assumes that the commodity is a pure, final product and the operator has incurred no additional charges during its production.

<sup>b</sup>Estimated revenue to industry is compiled from 1) revenue figures reported for the calendar year by major mine operators (accounting for actual sale

prices and including smelting and refining charges and transportation costs), except a theoretical first market value is substituted when actual mine revenue is unavailable; 2) calculated value of industrial materials (rock, sand, and gravel) produced from some State and Federal lands (table 17); and estimated gross operating income of placer mining operations from mining license tax forms as reported by the Department of Revenue (table 18).

<sup>c</sup>2011 and 2015 total missing significant expected data.

– = Not reported.

mines. However, most large operators do not differentiate production from development employment. Since 2014, development and production employment have been estimated for large operations when not specifically provided by the operator. The estimates are based on reported ratio of production to development expenditures, despite recognized limitations to this estimation method.

Placer employment continued a slight downward trend, and it is estimated that more than two-thirds of placer jobs (calculated as full-time equivalents) have been lost since the 2012 high. Estimated placer employment fell by three percent or four jobs between 2021 and 2022. Placer mining statistics are collected by DOR

and are shifted back a year to align the data more closely with the year of production, instead of the year in which the data were reported to DOR from operators. Placer mining employment in 2022 was estimated from the number of placer mines that reported gross operating income on Mining License Tax returns. This methodology is fully explained in table 18. Placer mine employment is challenging to quantify due to the large number of small or seasonal operations, sole-proprietors, and family-based businesses.

MSHA data indicate that coal mining employment remained steady from 2021 to 2022. Metal mining employment increased by 117 jobs (5 percent), placer mining employment decreased by 4 jobs (3 percent), and industrial

**Table 2.** Estimated Alaska mineral industry employment, 2010–2022<sup>a</sup>, as compiled from public documents, MSHA reporting<sup>b</sup>, personal communications, and other sources. The total employment number for an operation may be divided among exploration, development, and production activities based on the reported expenditures in those categories

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gold/silver mining													
Placer <sup>c</sup>	405	439	477	432	241	224	222	193	192	159	141	139	135
Lode	1,008	1,085	1,206	1,176	1,054	1,047	1,253	1,193	1,132	1,174	1,002	1,286	1,306
Polymetallic mining	350	364	386	390	287	303	306	324	316	342	326	381	455
Base metals mining	550	586	530	550	446	475	526	606	482	502	659	673	700
Recreational mining	35	41	52	55	7	–	–	–	–	–	–	–	–
Industrial minerals						173	253	197	237	272	198	188	
Sand and gravel	313	307	424	565	30	–	–	–	–	–	–	–	144
Rock	11	28	60	19	65	–	–	–	–	–	–	–	32
Coal	140	140	144	120	115	112	100	89	99	96	102	100	98
Peat <sup>d</sup>	3	3	4	–	<1	–	–	–	–	–	–	–	–
Tin, jade, soapstone, ceramics, platinum	–	–	–	1	1	–	–	–	–	–	–	–	–
Production (total of above categories)	2,815	2,993	3,283	3,308	2,246	2,230	2,660	2,602	2,458	2,545	2,427	2,767	2,870
Mineral development	537	422	535	358	468	555	412	536	638	622	494	470	488
Mineral exploration	520	535 <sup>e</sup>	548	385	253	116	160	254	373	319	303	453	509
<b>Total</b>	<b>3,872</b>	<b>3,950</b>	<b>4,366</b>	<b>4,051</b>	<b>2,967</b>	<b>2,901</b>	<b>3,232</b>	<b>3,392</b>	<b>3,469</b>	<b>3,486</b>	<b>3,225</b>	<b>3,690</b>	<b>3,867</b>

<sup>a</sup>Reported person-days are calculated on a 260-day work year and 10-hour work day to obtain average annual employment unless actual average annual employment numbers are provided.

<sup>b</sup>MSHA data: [arlweb.msha.gov/OpenGovernmentData/DataSets/MinesProdYearly.zip](https://arlweb.msha.gov/OpenGovernmentData/DataSets/MinesProdYearly.zip)

<sup>c</sup>See table 18 for updated information on placer employment calculations.

<sup>d</sup>This figure does not include all of the person-days associated with peat

operations; most of those person-days are included in sand and gravel numbers.

<sup>e</sup>Average of 520–550 range reported for 2011.

– = Not reported.

See Exploration, Development, and Production sections for further details.

materials production (rock, sand, and gravel) full-time-equivalent employment fell by 12 jobs (6 percent). While materials-sector employment (and production volumes and values) is underreported, the MSHA dataset captures its employment more completely than past voluntary reporting through questionnaires.

This report relies on a variety of sources to tabulate mineral industry employment, including publicly available company documents, personal communications, and questionnaires sent out by DGGS. Many exploration companies and mine operators voluntarily responded to questionnaires with 2022 employment information. Affidavits of Annual Labor also provided 2022 employment data for hard-rock exploration projects. Additional employment information was obtained from MSHA. These datasets and sources represent a minimum estimate and an incomplete picture of mineral industry employment in Alaska, but the values that are available add to the statewide mining employment total and provide a more complete estimate of the impact of mining to the State of Alaska's workforce and wealth-generation potential. Where actual annual employment numbers are not provided, full-time-equivalent positions are based on a 260-day work year and 10-hour workday. These datasets do not include placer employment.

DLWD provided 2022 mining employment and wage statistics based on 90 reporting units (companies) consisting of 55 metal ore, 1 coal and 34 nonmetallic-mineral quarrying units. Among companies in 2022, mining activities provided 3,488 jobs, down 2 percent from 3,573 jobs in 2021. DLWD data show that nonmetallic-mineral-product manufacturing provided 248 jobs, including 221 jobs in cement and concrete manufacturing, for 2022. Metal and mineral merchant wholesalers provided an average of 110 jobs at 10 companies during 2022.

According to DLWD data, 18 boroughs or census areas reported mining (excluding oil and gas) employment in 2022.

Wages for 2022 mining-sector jobs in Alaska were almost double the State's average annual wage of \$64,751. The average mining-sector wage in 2022 was \$120,051, a 7 percent increase from \$115,321 in 2021. Private-sector wages grew an average of 4 percent, slightly increasing the huge disparity between these wages. Up 9 percent from 2021, total wages paid by non-oil-and-gas mining firms in 2022 were \$418,739,339. At \$123,323 in 2022, metal ore mining positions averaged 3 percent higher than the average mining sector job.

DLWD employment data are based on wage records and include part-time jobs, but do not include the self-employed and working family members not covered under unemployment insurance. Most placer operators are self-employed and are therefore not counted in the DLWD data. Employment data may not include jobs in the exploration and development phases of mining at geological and engineering consulting firms that are categorized in the engineering, environmental, or construction industries. Consequently, mining's contributions to employment and earnings in Alaska are likely understated by DLWD's dataset.

An in-depth report prepared by the Alaska Miners Association (AMA) in consultation with the McKinley Research Group, estimates that Alaska's mining industry provided 11,400 total direct, indirect, and induced jobs in 2022 and around \$1.0 billion in wages statewide. The AMA report uses surveys and other research and analysis methods to include mining industry employment not captured by the DLWD and DGGS datasets. Based on data from the 6 large producing mines, 73 percent of employees at those mines are Alaska residents. Mining employees live in about 90 communities throughout Alaska.

According to the AMA McKinley Research Group report, 52 percent of the year-round jobs at the Red Dog Mine are filled by NANA Regional Corporation (NANA) shareholders. Jobs at Red Dog Mine are with Teck Alaska Inc.,

NANA Lynden Logistics, NANA Management Services (NMS), NANA Construction, Kuna Engineering, and Paa River Construction. At the Upper Kobuk Minerals projects in 2022, 37 percent of employees and contractors were NANA shareholders. At the Donlin Gold project, 54 percent of development jobs were filled by Alaska Natives. At the Pebble project, 66 percent of the workers were Alaska Native shareholders or their descendants.

## GOVERNMENT REVENUES FROM ALASKA'S MINERAL INDUSTRY

In 2022, government revenue from Alaska's mineral industry totaled \$189.8 million compared to \$96.7 million in 2021 (table 3). Significant increases in State claim rentals, production royalties, Alaska Industrial Development and Export Authority (AIDEA) facility user fees, and corporate income tax balanced significant decreases in State material sales, mining license tax, and payments to municipalities. Table 3 provides an itemized listing of estimated revenues paid to the State and municipalities. These revenues are incomplete and serve only as a minimum. Receipts from the Alaska Railroad Corporation for shipping commodities are related to mineral industry activities. Additionally, ADNR reported that \$146,547 were received in bond pool payments in 2020.

State Corporate Income Tax (CIT) collections in FY 2022 increased steeply, with payments exceeding \$17.8 million dollars. This continues the trend of extreme variability in this State revenue stream.

Operators and royalty payees reported total gross income of \$3.42 billion for mineral commodities that sold in tax year (TY) 2021 (December 1, 2020–November 30, 2021; table 4). This income is compiled from the Mining

License Tax returns filed in TY 2021 and is the most recent figure available at the time of this report. Total gross income from mining activity that occurred in TY 2022 will be reported in a future edition of this report. Total gross income from TY 2021 differs from the \$2.8 billion estimated revenue to industry in 2021 (table 1), as the latter is compiled for the calendar year and includes some theoretical first market values of mineral production that may not have been sold during that time period. The estimated revenue to industry also includes the value of untaxed sand and gravel products. Table 4 includes royalty-only taxpayers. Royalty-only taxpayers are typically landowners who receive revenue solely from a royalty share with no gross income from mining operations. All major mines in Alaska earn gross income from mining operations and their income is included in the table's values.

Mining License Tax collections increased almost 500 percent in 2022, from \$9.0 million in 2021 to \$53.5 million in 2022 (table 3). The Mining License Tax is 1.03 percent of all tax collections collected by the DOR. The Mining License Tax, unlike the Corporate Income Tax, does not have loss carryforward or carryback provisions, and therefore follows metal prices more closely. The DOR reported that 399 taxpayers submitted Mining License Tax returns in TY 2022 for production in the 2021 tax year, of which 38 (10 percent) were liable for taxes on net taxable income from mining in the amount of \$840.4 million, a 221 percent increase from TY 2020 net taxable income (table 4). Negative net taxable incomes from mining, at an average loss of \$63,181 per taxpayer, were reported by 132 taxpayers.

Municipal revenues increased in 2022 to a total of \$52.0 million, a 19 percent upswing from 2021 values. Mining-related activities were some of the largest contributions in the City & Borough of Juneau, the Fairbanks North Star Borough, and the Northwest Arctic Borough. Additionally, royalty payments to Native Corporations by way of the mining industry

**Table 3.** Reported and estimated revenues paid to the State of Alaska and municipalities by Alaska's mineral industry, 2017–2022. The figures in this table will change as data are reviewed and updated. The table has been significantly updated to reflect Department of Natural Resources and Department of Revenue reporting for previous years. See footnotes for reporting sources and dates

	2017	2018	2019	2020	2021	2022
<b>State mineral rents and royalties<sup>a,b</sup></b>						
State claim rentals	7,658,003	7,192,888	9,104,615	9,253,677	11,107,426	
Production royalties <sup>c</sup>	3,125,925	2,472,558	797,152	169,482	1,631,483	1,757,105
Annual labor	374,244	392,085	438,098	331,210	376,412	234,675
<b>Subtotal</b>	<b>\$ 11,158,173</b>	<b>10,057,531</b>	<b>10,339,865</b>	<b>9,754,369</b>	<b>13,115,321</b>	<b>12,744,097</b>
<b>State coal rents and royalties<sup>b</sup></b>						
Rents	268,866	231,159	223,799	415,454	205,276	1,105,689
Royalties <sup>c</sup>	2,232,394	1,971,999	2,519,086	2,375,927	2,649,306	2,184,003
Bonus	-	100	-100	-	-	-
<b>Subtotal</b>	<b>\$ 2,501,260</b>	<b>2,203,258</b>	<b>2,742,785</b>	<b>2,791,381</b>	<b>2,854,582</b>	<b>3,289,692</b>
<b>State material sales<sup>b</sup></b>						
Mental Health	24,366	50,558	15,144	2,700	406,192	-7983
Division of Land	4,637,844	4,540,134	6,734,784	2,831,123	1,741,602	3,575,834
State Pipeline Coordinator's Office	288,511	93,359	47,327	916,856	294,673	-522
<b>Subtotal</b>	<b>\$ 4,950,720</b>	<b>4,684,051</b>	<b>6,797,255</b>	<b>3,750,679</b>	<b>2,442,467</b>	<b>3,567,329</b>
<b>State mining miscellaneous fees<sup>b</sup></b>						
Filing fees	4,825	5,150	4,200	105,960	124,198	108,760
Bid bonus	-	-	-	205,506	-	-
Penalty fees	220,770	91,920	135,611	40,089	33,365	15,170
Exploration incentive app filing fee	-	-	-	-	-	-
Surface mine investment interest	-	-	-	193,448	-	-
Surface coal mining app fee	8,000	7,342	-653	-	-	-
APMA mining fees	21,302	29,024	66,171	-	-	-
<b>Subtotal</b>	<b>\$ 254,897</b>	<b>133,436</b>	<b>205,329</b>	<b>545,002</b>	<b>157,563</b>	<b>123,930</b>
<b>Other Fees</b>						
AIDEA - Facilities use fees <sup>d</sup>	10,014,951	9,081,619	8,129,483	6,975,615	5,626,965	23,188,591
State fuel taxes <sup>e</sup>	1,338,843	1,411,896	1,015,005	1,005,467	1,367,505	1,039,232
State corporate income tax <sup>f</sup>	-734,744	34,594,928	6,859,747	-7,733,308	1,880,036	17,837,108
Mining license tax <sup>e</sup>	41,525,192	47,297,409	47,777,544	35,043,196	9,001,811	53,500,843
Large mine permit coordination program receipts <sup>h</sup>	968,827	928,035	991,271	1,193,278	1,125,259	1,374,116
Alaska Railroad receipts <sup>i</sup>	21,200,000	15,900,000	17,400,000	15,200,000	15,500,000	21,200,000
<b>State Total</b>	<b>\$ 93,178,119</b>	<b>126,292,163</b>	<b>102,258,284</b>	<b>68,525,679</b>	<b>53,071,509</b>	<b>137,864,938</b>
Payments to municipalities <sup>j</sup>	48,628,626	34,282,140	41,481,284	50,555,237	43,583,242	51,979,829
<b>Total</b>	<b>\$ 141,806,745</b>	<b>160,574,303</b>	<b>143,739,568</b>	<b>119,080,916</b>	<b>96,654,751</b>	<b>189,844,767</b>

<sup>a</sup>Includes upland lease and offshore lease rentals. Figures are reported by calendar year by the Alaska Department of Natural Resources.

<sup>b</sup>Figures are reported by calendar year by ADNDR.

<sup>c</sup>Reported on a cash basis; payments actually received during the given year.

<sup>d</sup>AIDEA user fees for use of the State-owned roads and ports: the De Long Mountain Transportation System by Teck Alaska Inc., operator of the Red Dog Mine; and for use of the Skagway Ore Terminal by Minto Explorations Ltd., a subsidiary of Pembridge Resources. AIDEA figures are reported by fiscal year.

<sup>e</sup>Values from 2016–2021 were reported by the major operating mines, less their fuel tax refund.

<sup>f</sup>Only subchapter C corporations pay income tax. This report may not reflect 100% of the returns received in a year. The amount of corporate income tax reported in each fiscal year is the amount of tax actually received and may not agree with the amount reported on a corporation's tax return. This is due

primarily to timing differences.

<sup>g</sup>In 2012 and later, mining license tax was not collected on materials. Figures are reported by fiscal year. <http://tax.alaska.gov/programs/programs/reports/AnnualData.aspx?60610>

<sup>h</sup>The DNR Office of Project Management and Permitting (OPMP) recovers costs from applicants for large mine permit coordination, per AS 38.05.020(b)(9) and AS 37.05.146(b)(3). Figures are reported by fiscal year.

<sup>i</sup>Alaska Railroad revenue for transportation of coal, sand, and gravel. From *The Economic Benefits of Alaska's Mining Industry* published by the Alaska Miners Association, February 2021, and *The Economic Benefits of Alaska's Mining Industry* published by the Alaska Miners Association, May 2022. <https://www.alaskaminers.org/economic-benefits>.

<sup>j</sup>Payments to Municipalities include property taxes, payments in lieu of taxes (PILT), and severance taxes. Data should be considered a minimum estimate. Data were primarily provided by the major operating mines.

**Table 4.** Mining tax analysis by tax bracket for the 2019–2021 tax years, based on mining license tax returns. Analysis includes income from operations plus royalty income, including both royalty-only tax payers and those with both income from operations and royalty income. Information provided by the Alaska Department of Revenue. The figures in this table will change as data are reviewed and updated. Note yearly values reported by the Department of Revenue are adjusted to align with the production year

Bracket	Marginal tax rate	No. of taxpayers	Total gross income	Net taxable income*	Net income as percentage of gross	Total tax liability	Average gross income	Average taxable income	Average tax liability
<b>Tax Year 2019</b>									
Under \$0	0%	122	\$922,001,833	\$ -159,200,606	-17%	\$0	\$7,557,392	-\$1,304,923	\$0
\$0 to \$40,000	0%	200	\$7,696,287	\$1,217,823	16%	\$0	\$38,481	\$6,089	\$0
\$40,001 to \$50,000	3%	17	\$1,724,884	\$734,158	43%	\$22,025	\$101,464	\$43,186	\$1,296
\$50,001 to \$100,000	5%	7	\$2,269,644	\$469,267	21%	\$16,463	\$324,235	\$67,038	\$2,352
Over \$100,000	7%	18	\$1,451,343,312	\$371,786,579	26%	\$25,714,217	\$80,630,184	\$20,654,810	\$1,428,568
<b>Total</b>		<b>364</b>	<b>\$2,385,035,960</b>	<b>\$215,007,221</b>		<b>\$25,752,705</b>			
<b>Tax Year 2020</b>									
Under \$0	0%	118	\$24,679,598	\$ -14,861,572	-60%	\$0	\$209,149	-\$125,946	\$0
\$0 to \$40,000	0%	221	\$9,964,087	\$1,143,064	11%	\$22,886	\$45,086	\$5,172	\$104
\$40,001 to \$50,000	3%	8	\$364,431	\$324,593	89%	\$9,738	\$45,554	\$40,574	\$1,217
\$50,001 to \$100,000	5%	12	\$3,568,436	\$917,982	26%	\$33,899	\$297,370	\$76,499	\$2,825
Over \$100,000	7%	22	\$2,429,283,535	\$260,217,958	11%	\$17,671,262	\$110,421,979	\$11,828,089	\$803,239
<b>Total</b>		<b>381</b>	<b>\$2,467,860,087</b>	<b>\$247,742,025</b>		<b>\$17,737,785</b>			
<b>Tax Year 2021</b>									
Under \$0	0%	132	\$12,159,472	\$ -8,339,944	-69%	\$0	\$92,117	-\$63,181	\$0
\$0 to \$40,000	0%	229	\$28,213,026	\$929,025	3%	\$50,983	\$123,201	\$4,057	\$223
\$40,001 to \$50,000	3%	5	\$1,073,310	\$213,255	20%	\$6,398	\$214,662	\$42,651	\$1,280
\$50,001 to \$100,000	5%	13	\$4,063,896	\$919,545	23%	\$32,977	\$312,607	\$70,734	\$2,537
Over \$100,000	7%	20	\$3,370,892,578	\$839,237,099	25%	\$58,080,249	\$168,544,629	\$41,961,855	\$2,904,012
<b>Total</b>		<b>399</b>	<b>\$3,416,402,282</b>	<b>\$832,958,980</b>		<b>\$58,170,607</b>			

\*Net income taxable under the mining license tax.

Note: Taxpayers with negative income (under \$0) are not a separate bracket, but are reported separately to distinguish between large money-losing operations and small operations with zero or positive income.

totaled \$266 million.

The mining industry provided a total of \$4.5 million in charitable donations to 280 Alaska non-profit organizations, and \$2.7 million to the University of Alaska and vocational schools. Through sponsorship and membership fees, the mining industry contributed \$800,000 to civic, business, and industry organizations in Alaska.

In the Northwest Arctic Borough, Fairbanks North Star Borough, Denali Borough, and City & Borough of Juneau, mining companies paid the largest share of local taxes. Tax payments to local governments total \$55 million in 2022 including Kinross Fort Knox paying \$13 million in property taxes to the Fairbanks North Star Borough. Usibelli Coal Mine pays taxes to the Fairbanks North Star Borough, Matanuska-Susitna Borough, and Denali Borough. The two largest commercial taxpayers in the City & Borough of Juneau are Greens Creek Mine and Kensington Mine, paying \$1.9 million and \$1.4 million respectively.

Red Dog Mine made a \$25 million payment in lieu of taxes (PILT) payment to the Northwest Arctic Borough and a \$6 million payment to the Village Improvement Fund. The Borough has no sales tax or property tax, and Red Dog Mine is their largest source of revenue.

In certain jurisdictions, mining companies pay sales tax on local goods and services. For example, in Juneau, Greens Creek Mine paid an estimated \$727,230 in sales taxes in 2022.

AMA's report on mining lists other benefits to the State. In 2021, the Alaska Railroad Corporation received approximately \$15.5 million in payments for their transportation of coal, rock, sand, and gravel. AMA estimates that Alaska mines, mine development projects, and advanced exploration projects spent about \$1 billion in goods and services in 2022 from about 450 Alaska vendors.

## MINERALS-RELATED GOVERNMENT ACTIVITIES

### U.S. Geological Survey

The U.S. Geological Survey (USGS) Mineral Resources Program had multiple projects focused on the geologic framework and mineral resources of Alaska in 2022. Alaska Science Center research staff in Anchorage conducted field-based studies of the tectonic and metallogenic evolution of the Yukon–Tanana Upland, eastern Alaska, and on the geology and mineral resource potential of graphite on the Seward Peninsula.

Research staff at the Geology, Geophysics, and Geochemistry Science Center in Denver continued an exploration geochemistry study to identify potential indicator minerals in stream sediments and assess the utility of indicator minerals and hydrogeochemistry in the area containing the Pogo deposit in the Goodpaster Mining District. Research staff from Denver also continued to conduct studies on gold vein samples from the Pogo Mine and the Black Mountain district placer, together with gold provenance studies in the Fortymile and Fairbanks mining districts involving characterization of populations of gold particles according to both alloy compositions and suites of mineral inclusions (microchemical characterization).

The USGS conducted a GIS-based evaluation of the potential for sediment-hosted copper, volcanogenic massive sulfide (VMS), and porphyry copper deposits. A topical study of the Graphite Creek deposit, Seward Peninsula, was commenced to develop a geological model and salient criteria to be used for GIS analysis of regional flake graphite potential. Also, a USGS three-part mineral resource assessment was completed for tungsten skarn deposits in the Yukon–Tanana Upland. A quantitative

assessment was conducted in the vicinity of Fairbanks, and a qualitative assessment was done for the rest of the uplands.

USGS research staff from Anchorage and Denver also participated in national science planning for the USGS Earth Mapping Resource Initiative (Earth MRI) and developed multiple Alaska focus areas that have critical mineral potential and require new geological mapping, with geochemical and geophysical data acquisition. A USGS Open File Report presenting Alaska focus areas that have potential for antimony, barite, beryllium, chromium, fluor spar, hafnium, magnesium, manganese, uranium, vanadium, and zirconium was published in 2022 (Kreiner, D.C., Jones, J.V., III, and Case, G. N., 2022, Alaska focus area definition for data acquisition for potential domestic sources of critical minerals in Alaska for antimony, barite, beryllium, chromium, fluor spar, hafnium, magnesium, manganese, uranium, vanadium, and zirconium, chap. E of U.S. Geological Survey, Focus areas for data acquisition for potential domestic sources of critical minerals: U.S. Geological Survey Open-File Report 2019–1023, 19 p., <https://doi.org/10.3133/ofr20191023E>).

Alaska Science Center-led collaborative research on the geologic and metallogenic framework of Alaska's Eastern Interior produced numerous USGS data releases presenting U-Pb geochronology, Re-Os geochronology, zircon trace element geochemistry, and whole rock geochemistry. The data are available through USGS Science Base (<https://www.sciencebase.gov/>) and the Alaska Science Center Data Repository (<https://www.usgs.gov/centers/alaska-science-center/data>). These data releases accompany a forthcoming paper detailing the geochronology and time-space evolution of the Taurus district in Eastern Interior Alaska (Kreiner and others, in press). Research staff in Anchorage and Denver also continued to work on mapping and geochronology of gold veins in the Goodpaster district in collaboration with

industry partners.

The USGS announced in August that Alaska will receive more than \$6.75 million to conduct geologic mapping, airborne geophysical surveying, and geochemical sampling in support of critical mineral resource studies in the state. The funding comes from a \$74 million investment allocated to the USGS Mineral Resources' Earth MRI Program, provided through annual appropriations and investments from President Biden's Bipartisan Infrastructure Law. Overall, the Infrastructure Law provided \$510.7 million to the USGS to advance scientific innovation and map critical minerals.

The Earth MRI funding included grants to DGGs for geologic mapping and geochemical analyses for an area of the Yukon-Tanana Upland near the Canadian border. In addition, the USGS funding supports new airborne geophysical surveys in the Kuskokwim River region and in the Seward Peninsula. These data will help improve understanding of Alaska's critical mineral resources.

The USGS published a desktop study reviewing current knowledge regarding deep-ocean and coastal marine minerals within the marine areas surrounding Alaska, including the Alaska Outer Continental Shelf (OCS). The Alaska OCS encompasses several areas broadly conducive to marine mineral formation, including extensional basins resulting from an active subduction zone where massive sulfide deposits may form, deep abyssal plains with conditions that may lead to manganese nodule formation, seamounts that can provide substrate for the growth of ferromanganese crusts, and erosional settings and submerged continental crust where placer deposits are found. The study was published as Professional Paper 1870, Gartman, Mizell, and Kreiner, 2022, <https://doi.org/10.3133/pp1870>.

On February 24, 2022, pursuant to section 7002 of the Energy Act of 2020 (Public Law 116–260), the USGS published the “2022

Final List of Critical Minerals” in the Federal Register (87 FR 10381). The 2022 list of critical minerals, which revised the U.S. critical minerals list (CML) published in 2018 (83 FR 23295), included 50 mineral commodities instead of 35 mineral commodities or mineral groups. The changes in the 2022 CML from the prior 2018 CML were the addition of nickel and zinc, listing individual platinum-group metals and rare-earth elements, and the removal of helium, potash, rhenium, strontium, and uranium. The CML is to be updated at least every 3 years and revised as necessary consistent with available data.

On August 16, 2022, the Inflation Reduction Act of 2022 (Public Law 117–169) was signed into law with the aim to reduce inflation. Specifically related to critical minerals, it authorized \$391 billion in funding for climate change and domestic energy production. The legislation included targeted tax incentives aimed at manufacturing U.S.-sourced materials such as batteries, electric vehicles, solar, and wind parts and technologies like carbon capture systems. The legislation also includes key requirements around domestic sourcing, for example, for use of domestic steel in wind projects.

## U.S. Bureau of Land Management

The U.S. Bureau of Land Management (BLM)—Alaska administers and adjudicates all Federal mining claim locations in Alaska, manages mining and other activities on BLM-managed lands, and continues its mission to convey land to the State of Alaska as well as Alaska Native village and regional corporations. Annually, the BLM conveys thousands of acres of land to the State and Native corporations under the authority of the Alaska Statehood Act and the Alaska Native Claims Settlement Act (ANCSA).

Related to land management, the BLM continued research, identification, inventory, and inspection of closed Federal mining claims in anticipation of conveying those lands to the State of Alaska as the subject lands become available for selection and conveyance.

The Alaska Industrial Development and Export Authority (AIDEA) proposed to construct a 211-mile private industrial access road from mile post 161 on the Dalton Highway to the Ambler Mineral Belt as part of the Ambler Access project. A 50-year Right-Of-Way permit for the full length of the Ambler Road was signed by the U.S. National Park Service, the BLM, and AIDEA on January 6, 2021.

In May, the U.S. District Court for Alaska remanded approval of the Ambler Mining District Industrial Access Road project to the BLM for additional analysis. BLM’s supplemental Environmental Impact Statement (SEIS) will address identified deficiencies in its analysis of subsistence impacts and consultation with Tribes pursuant to section 106 of the National Historic Preservation Act (NHPA). The SEIS will ensure compliance with applicable law including the National Environmental Policy Act, the Federal Land Policy and Management Act, NHPA, and the Alaska National Interest Lands Conservation Act.

The BLM sought public input on the scope of the analysis, potential alternatives, and identification of relevant information and studies to help determine which additional impacts and resources should be more thoroughly assessed. The SEIS evaluated a range of alternatives and any potential impacts to biological, cultural, historic and subsistence resources such as caribou and fish, as well as measures to protect those resources. The BLM consulted with Alaska Native Tribes and Corporations throughout the process.

On Sept. 20, 2022, the BLM initiated a 45-day public scoping period to guide its supplemental evaluation of the proposed Ambler Mining District Industrial Access Road pursuant to an order by the U.S. District Court for Alaska. The BLM is seeking public input before preparing a SEIS to evaluate the proposal.

In August 2022, U.S. Secretary of the Interior Deb Haaland issued Public Land Order 7912 that made 27 million acres of BLM

land in Alaska available to selection by eligible Alaska Native veterans. The BLM's Alaska Native Vietnam Era Veterans Land Allotment Program, established by the John D. Dingell, Jr. Conservation, Management, and Recreation Act of 2019, provides eligible individuals with the opportunity to select an allotment of up to 160 acres from available federal lands in Alaska.

## U.S. Forest Service

Alaska contains 17 percent of all U.S. Forest Service lands and contains two of the largest national forests in the nation. U.S. Forest Service lands in Alaska cover 21,956,250 total acres and contain 1,170 miles of trails, 3,644 miles of road, and 63 placer and lode mines with operating plans.

## Alaska Department of Natural Resources Division of Mining, Land and Water

The Division of Mining, Land and Water (DMLW) manages mineral exploration and development on more than 96 million acres of State land in Alaska. In addition, the Division reviews and approves the operation and reclamation plans for mining projects, including coal, on all State, Federal, and private lands in Alaska. In 2022, the Division's Large Mine Permitting Team coordinated hard rock mine permitting activities at Red Dog, Fort Knox, Pogo, Kensington, Greens Creek, Nixon Fork mines, and Manh Choh (Tetlin) project. Permitting was also coordinated for advanced exploration projects, including Donlin Gold, Pebble, Graphite Creek, Palmer, Livengood Gold, and Upper Kobuk Mineral.

DMLW manages mineral exploration and placer mining through the Application for Permits to Mine in Alaska (APMA). In 2022 there were 643 operations with active APMAs, compared to 579 operations with active APMAs in 2021. Of these operations, 451 were for placer mining and exploration, 95 were for hard rock exploration, and 97 were for suction dredging activities.

The State regulates coal mining through the Coal Mining Regulatory program. DMLW inspected and permitted ongoing mining and reclamation at the Usibelli Coal Mine operations in Healy and inspection of inactive operations in the Wishbone Hill area. Flatlands Energy Corporation continued pursuing exploration permits for coal exploration in the Canyon Creek area south of Skwentna, where seven exploration holes were drilled in 2018.

The State Abandoned Mine Lands Program (AML) for the past seven years has actively reclaimed legacy coal mines that were left abandoned in the Healy Valley. AML is now focused on reclaiming the Cripple Creek pit, which will be accomplished in two separate phases. Phase I began in August of 2020 and was completed in September 2022. Phase II is projected to begin in 2024. The AML program will remain active in the Healy Valley for at least the next ten years, with the Apex pit projected for reclamation after the reclamation efforts are completed in the Cripple Creek pit.

## Alaska Department of Natural Resources Division of Geological & Geophysical Surveys

### *Mineral Resources Section*

The DGGs Mineral Resources Section uses its expertise in mineral deposit geology, geophysics, and geochemistry to evaluate State land for its potential to host undiscovered mineral resources. Section staff conduct geophysical surveys, geologic mapping, mineral-resource assessments, and ore deposit research; they also track mineral industry exploration and discoveries, development, and production. Additionally, the Section's expertise and knowledge are utilized to review other Departmental actions, including State land selection conveyance prioritization, land-use plans, land disposal actions, review of Federal actions, and infrastructure planning. The geophysical, geological, and resource surveys conducted by the Mineral Resources Section not

only inventory the potential for mineral resources but add value to the State's current and future revenue.

DGGS produced 20 publications related to mineral resources in 2022 (table 5). Since 1993 the data products of the Airborne Geophysical/ Geological Mineral Inventory (AGGMI) program have been an important component of successful resource-exploration programs. AGGMI products have contributed to the private-sector discovery of more than 22 million ounces of gold resources in the Salcha River–Pogo and Livengood areas (fig. 2). State budget cuts impacted the AGGMI program, resulting in the loss of a permanent staff position in the Mineral Resources Section and decreases in its annual funding for data collection and publication. New geophysical surveys now rely on funding from external sources or the State of Alaska capital budget.

### **Geophysical Datasets**

The Federal Fiscal Year 2019 Earth MRI-funded, Lower Tanana and Big Delta fixed-wing magnetic and radiometric surveys were delayed until 2022. From May 14 to August 4, 2022, DGGS collected new data for the Tanana River and Big Delta airborne magnetic and radiometric geophysical survey (<https://doi.org/10.14509/30899>). Funded by the USGS Earth MRI program, this survey covers parts of the Big Delta, Charley River, Circle, Eagle, Fairbanks, Kantishna River, Livengood, Mount Hayes, and Tanacross quadrangles near Fairbanks and Delta Junction (fig. 2).

The 2022 program completed the geophysical survey of the Yukon Tanana Upland focus area in Eastern Interior Alaska. Approximately 23,000 square miles of new magnetic and radiometric data were collected during 2020, 2021, and 2022. These data are primarily 400-meter line spacing, 300-meter ground clearance (“Tier II”) fixed wing surveys and lesser helicopter-based surveys.

These data will be used to improve the understanding of the geology and mineral

potential, support resource exploration, and contribute to the ongoing regional magnetic data coverage of the Yukon–Tanana Upland.

DGGS unveiled a new, interactive web map to explore geophysical survey distribution, availability, and data. The web map at [maps.dggs.alaska.gov/gp](https://maps.dggs.alaska.gov/gp) is constantly updated with new information.

### **Geologic Mapping and Geochemical Sampling**

The DGGS Mineral Resources Section performs geological mapping and geochemical sampling across Alaska to decipher Alaska's complex geology and to aid in the evaluation of perceived mineral-rich lands. This effort has been aided in recent years with funding through the USGS' newly created Earth MRI Program, which funds new geological mapping and geophysical surveys of areas that are prospective for discovery of strategic and critical minerals. This primarily federally funded project, supplemented with State matching funds, allows DGGS Mineral Resources geologists to create and disseminate geophysical and geological map products. These types of products have historically been shown to stimulate mineral industry interest, staking, and exploration activity in Alaska, as well as increase revenue to the State. The Earth MRI Program is expected to be a 10-year national program (beginning in 2019) funded at greater than \$10 million per year. In federal FY2022, Alaska received \$6.75 million in federal funds under this program.

During 2022, DGGS Mineral Resources geologists mounted their largest geologic mapping campaign in recent memory, fielding 12 geologists for 460 person-days of work in June, July, and August. The expanded mapping program is part of an ongoing effort to complete detailed mapping of the mineral-rich Yukon–Tanana Upland and was funded by the USGS Earth MRI program and the State of Alaska Capital Improvement Program. The 2022 field program finalized two mapping projects begun

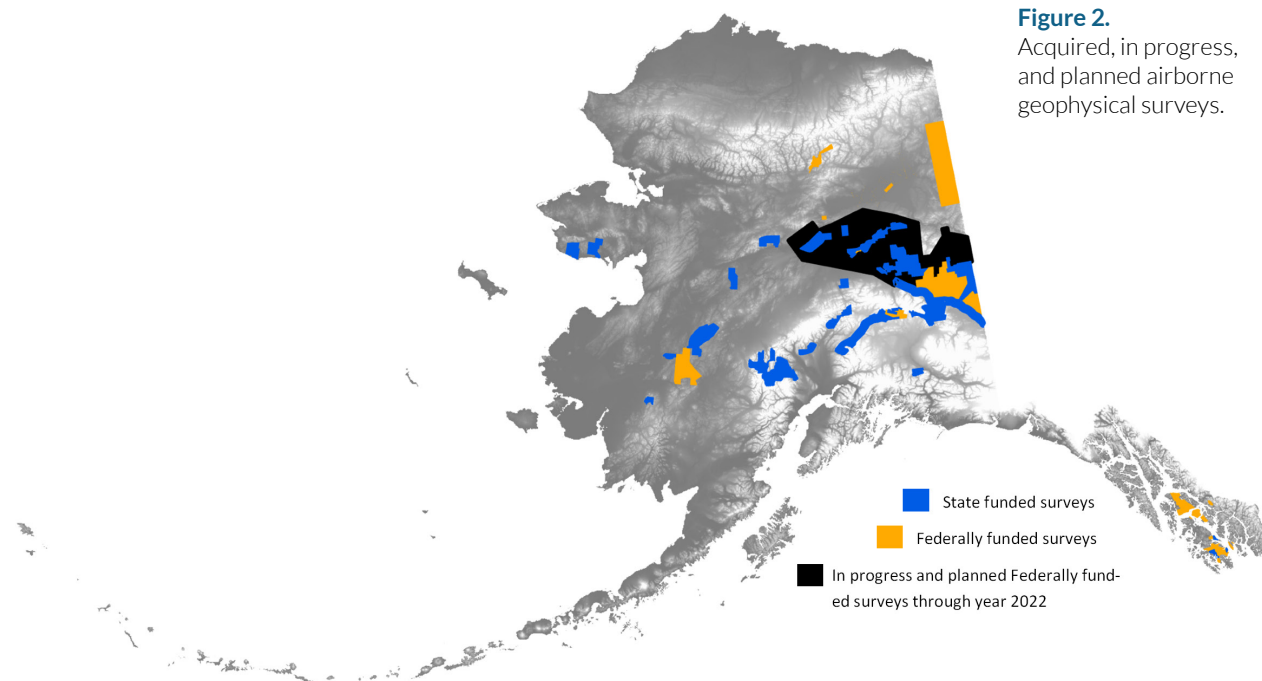
in 2021, both of which will be published in spring 2023. Geologists also began work on a 3,100 square mile area north of Delta Junction. The 2022 Mount Harper geologic map area lies just south of the Pogo Mine and includes the Naosi, Mon, and LMS gold deposits, the Healy, Eagle, and Democrat gold prospects, and the Mount Harper area tungsten and molybdenum prospects. Mapping for this project area will be finalized in 2023 and published in 2024.

The Mineral Resources Section published a geologic map of the Styx River area, Western Alaska Range and bedrock geologic maps of the eastern Moran area and northern Fairbanks Mining District. Other economic-geology themed reports, including geochemical and geochronological data releases tied to ongoing mapping projects, were also published (table 5).

One of DGGs' long-term goals is to create a seamless 1:100,000-scale geologic map of

**Table 5.** New mineral resource-related DGGs publications in 2022

Geologic maps, reports, and geochemical data
Alaska's mineral industry 2019 – <a href="https://doi.org/10.14509/30658">doi.org/10.14509/30658</a>
Northeast Tanacross geologic mapping project, Alaska – <a href="https://doi.org/10.14509/30537">doi.org/10.14509/30537</a>
Introduction to the northeast Tanacross geologic mapping project – <a href="https://doi.org/10.14509/30538">doi.org/10.14509/30538</a>
Northeast Tanacross geologic map and map units and descriptions – <a href="https://doi.org/10.14509/30539">doi.org/10.14509/30539</a>
Metamorphic cooling history of the Fortymile River and Lake George assemblages from 40Ar/39Ar geochronology from the northeast Tanacross and southeast Eagle quadrangles, Alaska – <a href="https://doi.org/10.14509/30540">doi.org/10.14509/30540</a>
Structural geology observations in the northeast Tanacross map area – <a href="https://doi.org/10.14509/30541">doi.org/10.14509/30541</a>
Geochemical interpretation of samples of igneous rocks from northeast Tanacross – <a href="https://doi.org/10.14509/30542">doi.org/10.14509/30542</a>
Observations on the economic geology of the northeast Tanacross map area – <a href="https://doi.org/10.14509/30557">doi.org/10.14509/30557</a>
Magnetic modeling of the northeast Tanacross map area – <a href="https://doi.org/10.14509/30558">doi.org/10.14509/30558</a>
U-Pb zircon ages from bedrock samples collected in the Tanacross and Nabesna quadrangles, eastern Alaska – <a href="https://doi.org/10.14509/30732">doi.org/10.14509/30732</a>
Geologic investigation of the Ladue River-Mount Fairplay area, eastern Alaska – <a href="https://doi.org/10.14509/30734">doi.org/10.14509/30734</a>
Bedrock geologic map of the Ladue River-Mount Fairplay area, Tanacross and Nabesna quadrangles – <a href="https://doi.org/10.14509/30735">doi.org/10.14509/30735</a>
Metamorphism of the Ladue River-Mount Fairplay area – <a href="https://doi.org/10.14509/30736">doi.org/10.14509/30736</a>
Regional correlation of metamorphic rocks in the Ladue River-Mount Fairplay map area using trace-element geochemistry – <a href="https://doi.org/10.14509/30737">doi.org/10.14509/30737</a>
Structural geology of the Mount Fairplay-Ladue River area – <a href="https://doi.org/10.14509/30738">doi.org/10.14509/30738</a>
Geochemistry of the igneous rocks in the Ladue River-Mount Fairplay area – <a href="https://doi.org/10.14509/30739">doi.org/10.14509/30739</a>
Economic geology of the Ladue River-Mount Fairplay area – <a href="https://doi.org/10.14509/30740">doi.org/10.14509/30740</a>
U-Pb detrital zircon geochronology of Cretaceous-Cenozoic sedimentary rocks in the Ladue River-Mount Fairplay area, Alaska – <a href="https://doi.org/10.14509/30683">doi.org/10.14509/30683</a>
Preliminary bedrock geologic map database, northeastern Richardson mining district, Alaska – <a href="https://doi.org/10.14509/30676">doi.org/10.14509/30676</a>
U-Pb zircon data and ages for bedrock samples from the Richardson mining district, Big Delta Quadrangle, Alaska – <a href="https://doi.org/10.14509/30676">doi.org/10.14509/30676</a>
2020 Alaska mining industry update (presentation) – <a href="https://doi.org/10.14509/30592">doi.org/10.14509/30592</a>
Geophysical surveys
Eagle airborne magnetic and radiometric geophysical survey – <a href="https://doi.org/10.14509/30755">doi.org/10.14509/30755</a>
White Mountains airborne magnetic and radiometric geophysical survey – <a href="https://doi.org/10.14509/30756">doi.org/10.14509/30756</a>
Icy Cape airborne magnetic geophysical survey, Southeast Alaska – <a href="https://doi.org/10.14509/29742">doi.org/10.14509/29742</a>



**Figure 2.**  
Acquired, in progress,  
and planned airborne  
geophysical surveys.

the state. Mapping at this scale (level of detail) optimizes the detail needed by researchers and resource developers while allowing geologic mappers to cover a reasonable area each year. Although about 80 percent of the state remains unmapped at this scale, DGGs is laying the groundwork for a statewide map compilation by standardizing digital geologic data from new and legacy mapping and making it accessible from a single database. By January 2023, DGGs will have published approximately 52 maps in the new standard. Also in January, DGGs will finalize an initial compilation project in the Yukon–Tanana Upland.

### **Alaska Geologic Materials Center**

The Alaska Geologic Materials Center (GMC), curated and operated by DGGs, is the State’s largest and most comprehensive archive of geologic samples. The GMC houses drill core from numerous Alaska mineral prospects, DGGs rock samples, and the Alaska collections of the U.S. Geological Survey, the former U.S. Bureau of Mines, and other agencies. The GMC archives 75 years’ worth of geologic data consisting of energy, mineral, and geologic collections with an estimated replacement value exceeding

\$35 billion. The 100,000 square foot facility in Anchorage provides a wide range of users (industry, government, academia, and public) access to samples for identifying new resource prospects and increasing our geologic knowledge of the state. The GMC holds more than 777,000 samples, including 42,998 mineral core boxes from 2,321 drillholes at 290 mineral prospects.

There were 611 visits to the GMC during 2022. This is about one-third of pre-pandemic client traffic, but 48 percent higher than last year. A database-driven search engine (<https://maps.dggs.alaska.gov/gmc>) allows users to quickly and easily view real-time details of nearly 724,000 public sample items in the GMC’s inventory before visiting the facility. This innovative and complex database and online search engine was developed in-house by DGGs staff and continues to serve user needs. There were 10,363 annual requests to GMC web pages. Mining industry visits increased for the third consecutive year and involved use of GMC core samples to identify a potential critical mineral lithium deposit in Southcentral Alaska.

The GMC’s non-destructive scanning project received \$1,880,000 as approved by

the State legislature. The GMC also received \$614,512 in a federal matching grant through the Federal Infrastructure Investment and Jobs Act. Funds will be used to purchase the hyperspectral scanning instrument and to support programming staff.

In support of this upcoming capability, GMC hosted the 2022 Rock Digitization Webinar Series. Global presenters comprising technology providers, academia, and government bureaus with expertise and actual experiences in creating digitalization processes for rock sample archives delivered fourteen talks (<https://dggs.alaska.gov/pubs/id/30877>).

### **Alaska Geospatial Office**

The Alaska Geospatial Office (AGO) was created in February 2021 to provide strategic oversight of the state's geospatial technology portfolio. AGO advances the use of geospatial technologies as a tool for better decision-making in Alaska, by coordinating statewide geospatial initiatives through the Alaska Geospatial Council. Overall, AGO strives to improve the quality of geospatial data in Alaska through coordination and collaboration with the larger GIS community.

AGO coordinates with data managers across the state to develop consistent standards and workflows; and to improve data quality, access, and management standards, thereby ensuring long-term viability of the state's geospatial data assets. The geoportal serves a total of 1,800 datasets and maps from 20 federal, state, and local governments across Alaska. In 2022, the State Geoportal was visited by more than 25,000 unique users, a 70 percent increase in users from 2021. The State Imagery Portal provides access to the most current statewide imagery. In 2022, AGO developed a new Imagery Portal for ingesting project level data from agencies across the state. The Imagery Portal received more than 142 million data requests from 100,578 unique users, up 500 percent from 2021, and served 25,000 gigabytes of imagery covering 2.6 million square miles of data.

Since the introduction of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS), Alaska has been in the forefront of implementing UAS technology. Alaska, through the University of Alaska, is home to one of the seven UAS test sites authorized by the Federal Aviation Administration. This year, the AGO added the Unmanned Aircraft Systems (UAS) and Drone Policy Working Group to establish safe and sustainable UAS operations across Alaska.

### **DGGS Geologic Information Center**

DGGS Geologic Information Center (GIC) personnel developed a centralized sample record management system for the multi-decades worth of field samples, sample descriptions, and other associated data collected by DGGS scientists. Sample and field station data are now available as an online GIS feature service and available to the public through the GMC inventory catalog (<https://maps.dggs.alaska.gov/gmc>).

In 2022, the GIC facilitated the publication of 50 new geologic reports, maps, and datasets, including 700 square miles of new geologic mapping. The GIC served over 25 Terabytes of digital geologic data and information from the DGGS website (<https://dggs.alaska.gov/>) and geoportals. The GIC also managed DGGS' public outreach efforts, which include 4,500 followers on Twitter, 530 subscribers to the division's news feed, over 1,700 followers on its Facebook page, and responded to hundreds of in-person, phone, and email information requests.

## **EXPLORATION**

Positive recovery from the COVID-19 pandemic, combined by strong metal prices and financing conditions, led to a strong mineral exploration season in 2022. Exploration spending in Alaska totaled \$305.8 million in 2022, a 12 percent increase from \$273.1 million spent in 2021 (figs. 3 and 4). Alaska activity paralleled global trends: estimated worldwide exploration

budgets increased by 16 percent year over year to \$13.0 billion from \$11.2 billion in 2021. The recovery in the exploration sector was faster than expected and driven by higher metals prices, increased financing activities and the decline of pandemic-related shutdowns. However, higher inflation, averaging eight percent during 2022, worsened financing and market conditions throughout the year.

To limit the spread of COVID-19 in exploration camps, mines, and neighboring communities, Alaska’s mineral industry companies continued to implement strict sets of COVID-19 protocols that included requiring negative COVID-19 tests prior to traveling to site and prior to departing sites, social distancing, encouraging COVID-19 vaccinations, face masks, and sanitization. Many sites contracted a medical service provider to administer rapid COVID-19 tests.

Exploration for gold in Alaska declined slightly in 2022, decreasing 2 percent from 2021 levels (table 6). Almost 53 percent of Alaska exploration dollars were spent on gold projects, boosted by increased exploration at Estelle, Goodpaster, Donlin Gold, Manh Choh, Golden Summit, Kensington, and Lucky Shot, among others (fig. 5). Exploration for base-metal and polymetallic deposits also increased in Alaska, especially for sediment-hosted and volcanogenic massive sulfide projects.

Seventy-one lode mineral exploration projects, some managed by the same company, reported activity in 2022. Excluding Alaska’s operating mines, 31 projects spent \$1 million or more on exploration. An additional 25 projects each spent \$100,000 or more. Southwest Alaska saw the most exploration, with more than \$89 million spent during 2022, mostly on gold-related projects. The Eastern Interior Region had almost \$55 million in spending, mostly on gold-related projects. Alaska’s Northern Region saw significant spending on volcanogenic and sediment-hosted polymetallic massive-sulfide deposits, with expenditures totaling \$84 million.

Exploration expenditures for gold vein and VMS deposits in Southeast Alaska were more than \$33 million. Western and Southcentral Alaska each had more than \$20 million spent on exploration for a variety of deposit types.

Alaska is perceived as an attractive place to explore for minerals. In 2022, the Fraser Institute annual survey of mining companies ranked Alaska 11<sup>th</sup> out of 62 worldwide jurisdictions for overall investment attractiveness by mining and exploration companies, which considers geologic potential as well as government policy factors that affect exploration investment. Alaska ranked 13<sup>th</sup> in the policy perception index that rated the attractiveness of policies for exploration investment.

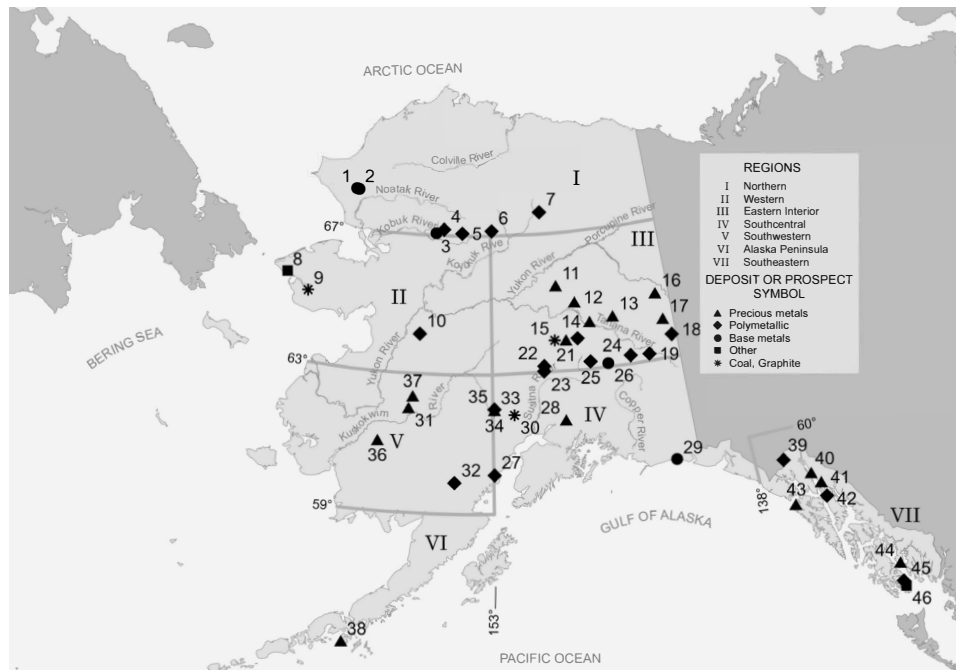
Alaska ranked 15<sup>th</sup> out of 47 jurisdictions for best practices mineral potential (i.e., world class regulatory environment, highly competitive taxation, no political risk or uncertainty, and a fully stable

mining regime). In other words, this potential represents, in a sense, a jurisdiction’s “pure” mineral potential, since it assumes a “best practices” policy regime. Alaska was perceived to have mining-friendly regulatory and fiscal policies, as well as attractive geological databases. Seventy-eight percent of survey respondents for Alaska indicated that they were able to get the necessary permits in less than 6 months, the third best performance for all surveyed jurisdictions. All the respondents for the state said that its level of transparency either encourages exploration investment or is not a deterrent to exploration investment. However, Alaska ranked poorly concerning quality of infrastructure.

The total area of the State covered by mining claims and prospecting sites in 2022 increased by ten percent to over 4.74 million acres (table

**ALASKA'S RANKINGS**  
out of 62 global mining jurisdictions

<b>11<sup>th</sup></b> for overall investment attractiveness	<b>13<sup>th</sup></b> for exploration policy attractiveness
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**Figure 3.** Selected exploration projects in Alaska, 2022.

## Exploration

### I. Northern Region

1. Lik—Solitario Zinc Corp.-Teck Alaska Inc.
2. Anjarraaq-Aktigiruiq —Teck Alaska Inc.
3. Bornite—Ambler Metals LLC
4. Arctic—Ambler Metals LLC
5. Sun—Valhalla Metals Inc.
6. Roosevelt—South32 USA Exploration Inc.
7. Wiseman West and Wiseman East— Wiseman Metals

### II. Western Region

8. Lost River — Lost River Mining Inc.
9. Graphite Creek—Graphite One Inc.
10. Illinois Creek-Waterpump Creek—Western Alaska Minerals Corp.

### III. Eastern Interior Region

11. Tolovana District
  - a Livengood (Money Knob)—International Tower Hill Mines Ltd.
12. Fairbanks District
  - a Fort Knox Mine and district—Kinross Gold Corp.
  - b Golden Summit—Freegold Ventures Ltd.
  - c NE Fairbanks-MHT-Treasure Creek—Felix Gold Ltd.
13. Goodpaster District
  - a Pogo Mine, Star, and Goodpaster—Northern Star Resources Ltd.
  - b 64North Gold—Millrock

Resources Inc.-Resolution Minerals Ltd.

14. Richardson Subdistrict
  - a SAM—Koza Ltd. (USA) Inc.-Great American Minerals Exploration, Inc.
15. Usibelli Coal Mine—Usibelli Coal Mine Inc.
16. Seventymile—Tectonic Metals Inc.
17. Napoleon—J2 Metals Inc.
18. Tanacross—Kenorland Minerals Ltd.
19. Manh Choh—Kinross Gold Corp.-Contango ORE Inc.
20. Red Mountain—White Rock Minerals Ltd.
21. White Gold—White Rock Minerals Ltd.
22. Golden Zone—Avidian Gold Alaska Inc.
23. Chulitna—Discovery Alaska Ltd.
24. Delta VMS Project—Agnico Eagle (USA) Ltd.
25. Alaska Range—PolarX Ltd.
26. Nikolai-Eureka Zone—Millrock Resources Inc.

### IV. South-central Region

27. Johnson Tract—HighGold Mining Inc.
28. Lucky Shot—Contango ORE Inc.
29. Icy Cape—Alaska Mental Health Trust Land Office
- 30.. Canyon Creek—Flatlands Energy Corporation

### V. Southwestern Region

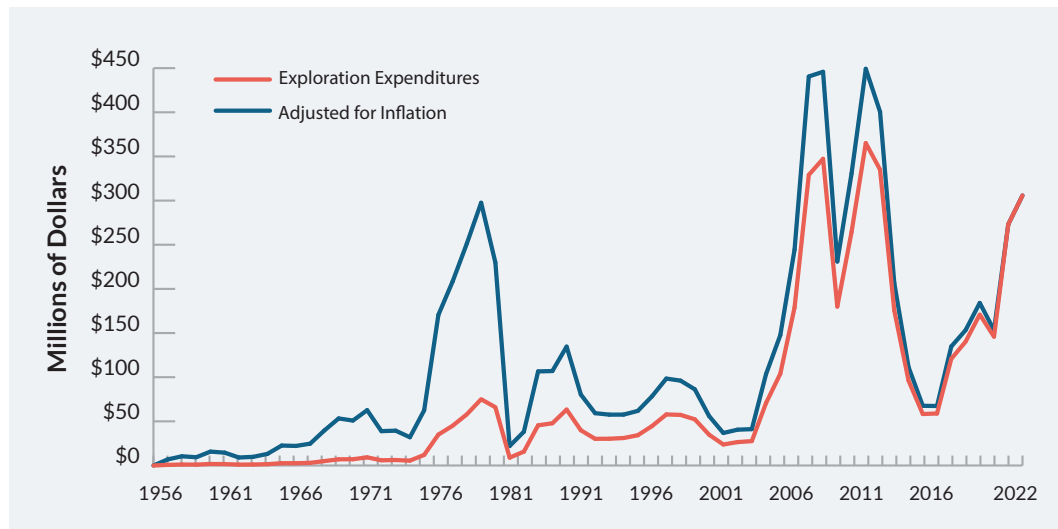
31. Donlin Gold—Donlin Gold LLC
32. Pebble—The Pebble Limited Partnership
33. Estelle—Nova Minerals Ltd.
34. Monte Cristo—Ragusa Minerals Ltd.
35. Whistler—GoldMining Inc.
36. Nyac—Calista Corporation
37. Flat—Tectonic Metals Inc.

### VI. Alaska Peninsula Region

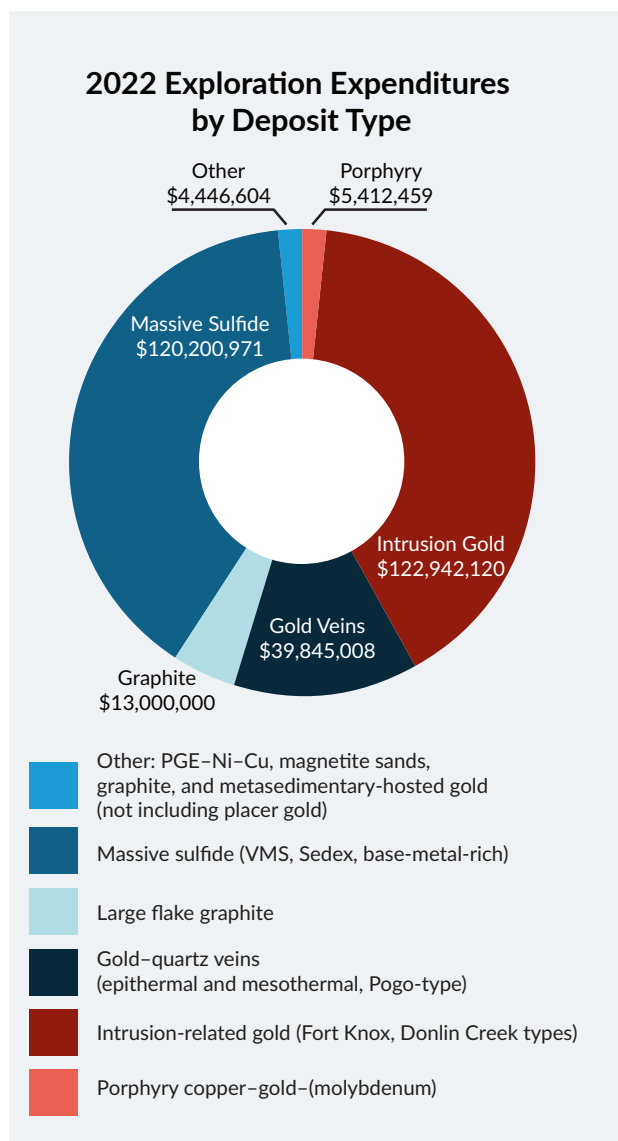
38. Unga—Heliostar Metals Ltd.

### VII. Southeastern Region

39. Palmer—Constantine Metal Resources Ltd.-Dowa Metals & Mining Alaska Ltd.
40. Kensington—Coeur Alaska Inc.
41. Herbert Gold—Grande Portage Resources Ltd.
42. Greens Creek Mine—Hecla Mining Company
43. Apex-EI Nido—Millrock Resources Inc.
44. Helm Bay—Agnico Eagle (USA) Ltd.
45. Niblack—Blackwolf Copper and Gold Ltd.
46. Bokan Mountain—Ucore Rare Metals Inc.



**Figure 4.** Alaska mineral exploration expenditures, 1956–2022. Blue line is adjusted for inflation to 2022 dollars.



**Figure 5.** Exploration expenditures by deposit type, 2022.

7). Total area of State mining claims increased by more than ten percent to 4.61 million acres, while total Federal mining claims decreased one percent to 134,860 acres. The total number of active 40-acre claims increased by almost 9 percent while the number of 160-acre claims increased by almost 14 percent.

### Northern Region Aᅇarraaq-Aktigirua

Teck Alaska Inc. continued exploration at their Aᅇarraaq deposit and Aktigirua prospect, which lie about eight miles northwest of the Red Dog Mine. The Aᅇarraaq deposit holds an inferred resource of 21 million tons grading 14.4 percent zinc, 4.2 percent lead, and 2.13 ounces of silver per ton (app. D). Preliminary exploration of the nearby Aktigirua target suggests a potential resource in the range of 88–165 million tons of mineralization grading 16–18 percent combined zinc plus lead. If confirmed, Aktigirua would be one of the largest undeveloped zinc deposits in the world, comparable in total size to all past production and current reserves at Red Dog Mine.

Exploration during 2022 consisted of diamond drilling. Drilling totaled 22,969 feet in 10 drill holes on the Noatak claim group.

#### Lik

Teck and 50 percent co-owner Solitario

**Table 6.** Reported exploration expenditures in Alaska by commodity, 1981–2022. All 2022 exploration expenditures were reported by the company; no estimates were utilized in the compilation

	Base metals	Polymetallic <sup>a</sup>	Precious metals <sup>b</sup>	Industrial minerals	Coal and peat	Other <sup>c</sup>	Total
1981	\$ 28,262,200	–	\$ 35,273,200	\$ 10,300,000	\$ 2,341,000	\$ 127,000	\$ 76,303,400
1982	31,757,900	–	10,944,100	–	2,900,000	15,300	45,617,300
1983	9,758,760	–	20,897,555	2,068,300	1,338,454	70,000	34,133,069
1984	4,720,596	–	14,948,554	270,000	2,065,000	279,500	22,283,650
1985	2,397,600	–	6,482,400	–	270,000	–	9,150,000
1986	1,847,660	–	6,107,084	170,000	790,000	–	8,914,744
1987	2,523,350	–	11,743,711	286,000	1,150,000	31,000	15,734,061
1988	1,208,000	–	41,370,600	160,200	2,730,000	–	45,468,800
1989	3,503,000	–	43,205,300	125,000	924,296	5,000	47,762,596
1990	5,282,200	–	57,185,394	370,000	321,000	97,000	63,255,594
1991	4,789,500	–	34,422,039	92,000	603,000	2,000	39,908,539
1992	1,116,000	\$ 3,560,000	25,083,000	25,000	425,000	0	30,209,000
1993	910,000	5,676,743	23,382,246	163,500	0	125,000	30,257,489
1994	600,000	8,099,054	18,815,560	225,000	2,554,000	810,000	31,103,614
1995	2,770,000	10,550,000	20,883,100	100,000	0	3,000	34,306,100
1996	1,100,000	11,983,364	31,238,600	400,000	0	0	44,721,964
1997	1,700,000	22,347,000	32,960,500	80,000	720,000	0	57,807,500
1998	1,000,000	13,727,000	42,441,000	12,000	87,000	0	57,267,000
1999	3,869,000	3,168,000	44,891,000	1,000	0	410,000	52,339,000
2000	8,545,000	3,933,000	21,579,000	58,500	0	736,100	34,851,600
2001	4,810,000	1,977,000	15,820,000	50,000	10,000	1,106,000	23,773,000
2002	1,700,000	5,162,000	17,342,000	185,000	0	2,113,000	26,502,000
2003	262,000	7,081,000	19,726,000	0	0	533,000	27,602,000
2004	3,100,000	40,237,000	26,954,000	213,000	50,000	258,000	70,812,000
2005	1,764,000	54,271,000	46,255,000	142,000	0	1,463,000	103,895,000
2006	5,069,000	81,073,000	89,793,000	20,000	2,394,000	580,000	178,929,000
2007	38,888,000	123,487,500	155,601,400	42,500	7,675,000	3,447,000	329,141,400
2008	30,116,000	163,030,000	134,885,000	0	0	19,238,000	347,269,000
2009	3,862,715	85,871,529	84,020,531	17,850	0	6,193,518	179,966,143
2010	6,392,519	122,955,321	125,364,382	19,000	6,520,200	3,104,199	264,355,621
2011	7,730,891	160,880,974	186,255,005	–	3,250,000	6,962,325	365,079,195
2012	18,161,211	150,339,009	152,444,311	–	W	14,129,838	335,074,369
2013	8,122,810	103,524,782	60,977,949	22,762	W	2,840,713	175,489,016
2014	8,310,433	29,836,240	51,759,541	32,221	W	6,300,413	96,238,848
2015	6,199,064	25,171,955	26,907,877	–	–	–	58,278,896
2016	7,820,283	25,295,705	24,857,804	–	–	912,510	58,886,302
2017	16,207,528	48,325,468	53,605,626	–	W	2,669,363	120,807,985
2018	11,932,106	57,693,015	66,168,235	–	W	4,278,600	140,071,956
2019	16,109,000	80,523,572	69,023,716	–	W	5,320,390	170,976,678
2020	–	43,517,449	100,223,594	10,000	–	2,106,830	145,857,873
2021	1,271,972	89,798,692	166,413,849	–	–	15,622,002	273,106,515
2022	12,917,016	113,148,532	162,462,972	–	–	17,318,643	305,847,163
<b>Total</b>	<b>\$ 315,490,298</b>	<b>\$ 1,583,096,372</b>	<b>\$ 2,218,252,763</b>	<b>\$ 15,660,833</b>	<b>\$ 39,117,950</b>	<b>\$ 101,889,601</b>	<b>\$ 4,273,507,817</b>

<sup>a</sup>Polymetallic deposits considered a separate category for the first time in 1992.

<sup>b</sup>Approximately \$0.94 million spent on platinum-group-element (PGE-Ni-Cu) exploration during 2014, included in the polymetallic category. Prior to 2013, PGE exploration was included in the precious metal exploration total.

<sup>c</sup>Includes rare-earth elements, magnetite sands, graphite, and other common deposit types.

N/A = Not available

– = Not reported

W = Withheld; data included in "Other" column

Zinc Corp. conducted limited exploration at the Lik zinc–lead–silver sediment-hosted massive sulfide deposit, twelve miles northwest of the Red Dog Mine. Lik hosts two massive sulfide deposits with a total indicated resource of 19.4 million tons grading 8.07 percent zinc, 2.68 percent lead, and 1.60 ounces of silver per ton, and an inferred resource of 3.09 million tons grading 8.64 percent zinc, 2.73 percent lead, and 1.25 ounces of silver per ton (app. D).

The two main activities completed in 2022 at the Lik property consisted of the first drilling program in nearly 10 years and a ground gravity geophysical survey completed northwest of the Lik deposit. Solatario also published a technical report summary on the Lik deposit, including a new mineral resource. The new mineral resource for the Lik deposits contains indicated and inferred resources totaling 3,665.2 million pounds of zinc, 1,208.7 million pounds of lead, and 31.85 million ounces of silver.

Three widely spaced core holes totaling 2,415 feet were completed. Drill hole Lik-231 intersected 11.5 feet grading 9 percent zinc and 3 percent lead from 778 to 790 feet, including 5.4 feet grading 14 percent zinc and 4 percent lead. It extended mineralization approximately 330 feet downdip and to the west of the existing Lik resource. The other two core holes did not intersect significant mineralization.

A gravity ground survey was completed across the entire northwestern half of the property with survey stations every 1,300 feet. A weak-to-moderate gravity anomaly was detected approximately 1.2 miles to the northwest of the Lik deposit. Reconnaissance geologic mapping helped define both the stratigraphy and structural complexity of a large area northwest of the Lik deposit.

## **Ambler Mineral Belt**

### **Upper Kobuk Mineral Projects**

The Upper Kobuk Mineral Projects (UKMP) is located within the Ambler Mineral Belt in the southern Brooks Range and hosts

world-class polymetallic VMS deposits (including Arctic) that contain copper, zinc, lead, gold, and silver; and carbonate-replacement deposits (including Bornite) that host high-grade copper and cobalt mineralization. The UKMP is operated by Ambler Metals LLC, a 50/50 joint venture formed in February 2020 between Trilogy Metals Inc and South32 Limited.

Field season activities at the UKMP commenced in late May, with the camp opening on May 20 and drilling completed on September 16. Ambler Metals employed 142 seasonal workers during the summer. Three drill rigs worked on UKMP, with two rigs focused on the Arctic deposit, and the other rig split between the Bornite area, Cosmos Hills and the Ambler mineral belt. A total of 35,230 feet of diamond drilling was completed at the UKMP.

### **Arctic**

Trilogy Metals Inc. announced Feasibility Study results for the Arctic Deposit, including mineral resources (app. D) in 2020, demonstrating the technical and economic viability of establishing a conventional open-pit copper–zinc–lead–silver–gold mine and mill complex operating at 11,000 tons per day over a 12-year mine life. Total life of mine production is projected at 1.9 billion pounds of copper, 2.3 billion pounds of zinc, 388 million pounds of lead, 386 thousand ounces of gold, and 40.6 million ounces of silver.

Within the Arctic deposit, mineralization occurs as stratiform semi-massive sulfide to massive sulfide beds within primarily graphitic chlorite schists and fine-grained quartz schists. The sulfide horizons average 13 feet in thickness but vary from less than 3 feet up to as much as 65 feet in thickness.

Semi-massive to massive mineralization at the Arctic deposit consists of chalcopyrite, sphalerite, pyrite, with lesser galena, trace native copper, bornite, chalcocite, covellite, and variable pyrrhotite. Barite content varies widely within and surrounding the sulfide layers. Mineralization

**Table 7.** Summary of claim activity, 1991–2022

Year <sup>a</sup>	State Claims				State Prospecting Sites (160 acres)		Federal Claims (20 acre sites)	
	New (Active) 40 acre <sup>b</sup>	New (Active) 160 acre	Total (Active) 40 acre <sup>b</sup>	Total (Active) 160 acre	New	Total	New	Total
1991	3,277	0	37,862	0	747	1,723	1,299	23,222
1992	2,640	0	36,250	0	454	1,472	695	20,254
1993	2,120	0	34,340	0	1,412	2,259	601	9,298
1994	4,057	0	34,400	0	802	2,378	341	8,495
1995	4,512	0	30,464	0	1,030	2,725	376	7,766
1996	9,489	0	36,602	0	2,082	3,687	681	9,346
1997	8,678	0	42,836	0	2,480	5,305	1,872	11,320
1998	9,786	0	49,816	0	3,194	7,148	427	11,033
1999	11,978	0	56,107	0	1,755	7,600	308	10,176
2000	4,560	614	54,393	614	1,143	5,675	523	7,805
2001	858	907	49,627	1,503	27	3,091	464	8,248
2002	745	826	44,056	2,179	61	2,138	261	8,100
2003	856	2,603	38,076	4,387	101	1,857	676	8,424
2004	1,070	3,533	34,380	7,719	59	1,484	66	8,313
2005	806	4,502	34,066	11,551	128	1,612	411	7,826
2006	1,111	5,747	33,864	16,249	103	1,646	457	8,068
2007	576	6,031	31,305	20,208	57	1,625	933	8,872
2008	1,333	2,565	23,033	13,519	24	651	3,001	11,732
2009	1,142	2,793	24,340	16,381	40	335	1,057	10,431
2010	1,446	6,132	24,805	20,389	88	441	332	8,413
2011	1,932	4,893	24,319	21,970	180	273	284	8,438
2012	1,638	3,478	24,673	20,810	202	409	632	–
2013	1,622	2,155	24,883	17,347	28	209	289	6,916
2014	1,219	677	25,479	15,250	19	197	69	6,003
2015	1,014	711	26,493	15,961	21	36	71	6,074
2016	1,164	893	21,303	9,887	21	31	37	5,656
2017	1,713	3,453	22,175	12,074	44	85	695	6,259
2018	1,083	2,319	19,757	17,948	23	113	87	6,248
2019	1,063	3,508	19,245	16,303	90	131	90	6,216
2020	1,357	3,613	16,721	19,880	577	586	135	6,312
2021	552	2,384	17,290	21,152	5	586	712	6,817
2022	551	1,737	18,826	24,081	–	–	127	6,743

Information provided by Alaska Department of Natural Resources and U.S. Bureau of Land Management. The figures in this table will change as data are reviewed and updated.

<sup>a</sup>After 2010, State claim and prospecting site totals are not directly comparable to previous years. After 2016, new State prospecting sites and total prospecting sites are not directly comparable to previous years. Claim totals comprise Mining Claims (including "River Bottom Navigable"

subtype) and Leasehold Locations whose claimants filed an Annual Affidavit of Labor, and claims initiated on State-selected land. There were 1,561 "at-risk" 40-acre claims and 1,505 "at-risk" 160-acre claims on State-selected land in 2021. There were 22 new offshore prospecting permit applications (up to 2,560 acres) in 2022, with no approval of those permits in 2022.

<sup>b</sup>Includes claim fractions varying from 1 to 39 acres.

– = Not reported

contains periodic bands of massive sulfides with quartz-chlorite-talc-calcite gangue; where generally, mineralization is composed of short, massive sulfide bands in chlorite-talc rocks.

Ambler Metals completed the largest drilling program ever conducted at the Arctic deposit. Drilling totaled 27,480 feet in 47 holes as part of an infill program to increase confidence of the resource from Indicated to Measured. The drilling included five holes totaling 2,674 feet completed for the geotechnical assessment of Arctic that was initiated in 2021 and two infill holes instrumented for ongoing hydrogeological assessment.

Significant intersections of high-grade copper, zinc, lead, gold, and silver mineralization are listed in table 8. Mineralization intersected in hole AR22-0205 represents the highest grade-thickness intersection of all 237 holes drilled at the Arctic project, as determined by Ambler Metals.

The 2022 field program improved confidence in the mineral resource at the Arctic deposit and completed geotechnical studies. Ambler Metals was in the final stages of completing the Arctic prefeasibility study.

### **Bornite**

Bornite is a carbonate-hosted copper deposit with associated cobalt and germanium (app. D). Known mineralization consists of three stratabound copper bodies or ‘reefs’ that plunge

northeast at about 25 degrees. These include the Lower and Upper reefs, referred to as the Ruby zone, with both in-pit and below-pit resources. Approximately 800 feet southeast of the Ruby zone is the South Reef zone, discovered in 2011. South Reef’s 2 percent copper shell starts at about 1,300 feet below surface and plunges to the northeast at about 25 degrees to approximately 3,300 feet below surface. The true thickness of the resource at South Reef is variable, ranging from 16 feet to over 125 feet and averages about 60 feet.

The geology of the Bornite resource area is composed of alternating intervals of carbonate rocks (limestone and dolostone) and calcareous phyllite. Limestone transitions laterally into dolostone near zones of mineralization and is hydrothermally altered. The Bornite sequence is now interpreted as a tectonized “normal” carbonate slope deposit that consists of calcitic material (lime mud) derived from a nearby shallow-marine source area, interlayered with variable amounts of terrigenous mud. Importantly, superimposed on the active limestone slope system is the local presence of dolostone-clast conglomerate that are likely derived from subaqueous horst blocks of pre-existing older dolostone that shed into the slope limestone system. Copper mineralization at Bornite is comprised of chalcopyrite, bornite, and chalcocite as stringers, veinlets, and breccia fillings distributed in stacked, roughly stratabound zones exploiting favorable

**Table 8.** 2022 Significant Arctic project drilling results. Length refers to the length of the mineralized interval in each drillhole [opt = ounces per ton; CuEq=copper equivalent grade in percent; \* - copper equivalent determined by Ambler Metals LLC]

Hole	Length (ft)	Cu (%)	Zn (%)	Pb (%)	Ag (opt)	Au (opt)	CuEq (%)*
AR22-0205	140.33	3.09	6.21	1.46	2.104	0.024	7.04
AR22-0211	15.62	4.39	4.57	0.60	1.272	0.018	7.04
AR22-0211	17.52	9.33	7.59	0.59	1.743	0.006	12.98
AR22-0214	20.18	3.97	5.79	0.60	1.331	0.014	7.01
AR22-0216	40.45	3.23	5.16	1.33	1.451	0.021	6.48
AR22-0221	147.74	2.36	2.78	0.24	0.614	0.009	3.84
AR22-0230	63.82	8.71	9.54	1.84	3.015	0.053	14.90

stratigraphy. Cobalt mineralization at Bornite is comprised of cobaltiferous pyrite, within and enveloping the copper mineralized zones, and carrollite and cobaltite directly associated with copper bearing minerals.

Two holes, totaling 2,359 feet, were drilled in the Cosmos Hills by Ambler Metals. Drilling was planned for the Bornite West, Pardner Hill, and Ambler Lowlands areas. Drilling locations and results were not released. In addition, 4,430 feet of trenching and trench mapping were completed around Pardner Hill.

Trilogy Metals Inc released an updated mineral resource estimate for the Bornite project. The Bornite project is estimated to contain in-pit indicated mineral resources of 46.0 million tons grading 1.04 percent copper and in-pit inferred mineral resources of 103.5 million tons grading 0.98 percent copper, at a 0.50 percent copper cut-off grade. The in-pit indicated mineral resources total 955 million pounds of copper and inferred mineral resources total 2.0 billion pounds of copper.

Below the resource limiting pit shell, and at a base case cut-off grade of 1.5 percent copper, the combined South Reef and Ruby zone is estimated to contain additional inferred mineral resources of 55.5 million tons grading 2.97 percent copper, totaling 3.3 billion pounds of contained copper.

The total cobalt inferred mineral resource (in-pit and below pit), based on a cut-off grade of 0.5 percent copper, is 204.8 million tons grading 0.021 percent cobalt for 88 million pounds of contained cobalt.

### **District-Wide Exploration**

Exploration by Ambler Metals in the broader Ambler Mineral Belt included drilling, geologic mapping, and geochemical soil sampling. Regional drilling focused on near Arctic (Arctic Hub) exploration targets, with the goal of discovering nearby copper-rich satellite deposits within a two-to-three-mile radius of the Arctic deposit. Ambler Metals completed 5,394

feet of core drilling at two prospects. Extensive soil sampling and geologic mapping were also done in the region, with 39,947 samples taken. Four mappers and 13 soil samplers covered ground at over 20 prospects and targets including Tom Tom, Z, East Dead Creek, Arctic East, Nani, Luk, Cynbad, and numerous Versatile Time Domain Electromagnetic (VTEM) anomalies.

The 98-9 prospect, about two miles northeast of the Arctic deposit, was discovered by Kennecott in 1998 but never drilled. Four holes totaling 4,590 feet at the 98-9 prospect tested copper oxide mineralization occurrences found within a 170-foot vertical thickness of folded and altered Ambler sequence and an associated VTEM anomaly. No drill results were announced.

The East Dead Creek prospect, about 3.7 miles northwest of the Arctic deposit, has sub-cropping gossan, intense alteration of Ambler sequence rocks, and several strong shallow conductors above a weakly conductive horizon. The East Dead Creek VTEM anomaly and a shallow stratigraphic target was tested with one hole totaling 804 feet. No drill results were announced.

### **Ambler Industrial Access Road**

The Ambler Access Project (AAP), formerly referred to as the Ambler Mining District Industrial Access Project or Ambler Road, is being executed by the Alaska Industrial Development Economic Authority (AIDEA) to provide future road access to the mineral resources of the Ambler Mineral Belt. AIDEA and Ambler Metals signed an agreement in 2021 to form a 50/50 partnership for the AAP.

Members of the Subsistence Advisory Committee were selected and held their first meeting in January of 2022. Stakeholder outreach also established a Workforce Development Working Group.

In February 2022, the U.S. Department of the Interior sought a voluntary remand of the

2020 Joint Record of Decision for the AAP. The U.S. District Court for Alaska granted voluntary remand in May 2022 so the BLM could conduct a SEIS. The BLM held a 45-day public scoping study period on the SEIS from September 20 to November 4, 2022. The purpose of the SEIS was to further evaluate subsistence impacts to fish and caribou habitat and address the desire for additional tribal consultation. The BLM anticipated publishing a draft SEIS, open for public comment, during the second quarter of 2023.

Fieldwork on the AAP was suspended while awaiting actions by the BLM. In August, the BLM issued a conditional approval of AIDEA's 2022 Fieldwork Annual Work Plan. Permit delays significantly shortened the project's 2022 field season. A total of 26 Alaska Native shareholders were hired for summer fieldwork including tribal liaisons, archaeological technicians, landing zone clearing crews, and bear guards. Cultural resources teams surveyed potential sites for resources of cultural, spiritual, and/or religious importance. Teams prepared helicopter landing zones for future access along the proposed project route.

### **Sun**

Valhalla Metals Inc.'s Sun property includes the volcanogenic massive sulfide Sun deposit, with an 11.8-million-ton polymetallic resource (app. D) and several other prospects and targets. Mineralization at Sun is hosted by at least two polymetallic massive and semi-massive sulfide horizons containing primarily pyrite, sphalerite, chalcopyrite, galena, and tetrahedrite-tennantite with other accessory sulfide minerals. The current Sun claim block is 392 claims that cover 62,720 acres.

SolidusGold Inc. released an updated technical report on the Sun property, including updating a Canadian NI 43-101 compliant resource on the Sun deposit. Through the reverse takeover of SolidusGold Inc., Valhalla Metals Inc. is listed on the TSX Venture Exchange in 2022.

Valhalla Metals completed detailed conductive plate modeling on geophysical data collected from helicopter VTEM and magnetic surveys completed in 2019. Valhalla also conducted rock and soil geochemical sampling and prospecting.

### **Smucker**

The Smucker deposit is located on the western edge of the Ambler Mineral Belt in the southern Brooks Range and contains significant copper, zinc, lead, silver, and gold mineralization in a stratabound VMS deposit (app. D). The Smucker claimblock is held by Teck Resources Inc. and Valhalla Mining LLC also staked mining claims in the immediate area. Potential extensions of the mineralized horizon remain largely untested and open at depth and laterally.

Valhalla Metals Inc.'s interest in the Smucker property is subject to an ongoing dispute between Teck, Valhalla Mining, and ADNR. In November 2018, Teck and ADNR notified Valhalla Mining that 11 of the 58 mineral claims comprising the Smucker property were invalid to the extent of those claims overlapped the old Teck claims block at Smucker.

Valhalla Mining succeeded in its claims to quiet title to the disputed mining claims in April 2021 at the Alaska Superior Court. The Court's decision was appealed to the Alaska Supreme Court by Teck and ADNR on April 27, 2021. A final resolution of the appeal is expected in early 2023.

Valhalla Metals staked 76 claims adjacent to the Smucker block in September 2022.

### **Roosevelt**

South32 USA Exploration Inc. conducted work on the eastern extension of the Ambler Mineral Belt at the Roosevelt prospect. Massive sulfide mineralization was discovered at Roosevelt Creek by Anaconda Alaska in the late 1970s. The 2022 program continued work to identify drill targets.

Geological mapping was conducted at a

1:5000 scale over 13 prospect areas identified from previous work (Roosevelt, Roosevelt West, Franklin, Red, Middle Ridge, Jones, Grybeck, Malamute, Malamute South, Mettenpherg Creek, King, Michigan Creek and Ipnek). Geochemical work included the collection of 265 surface rock grab samples, 5,162 soil samples, and 25 stream sediment samples for geochemical analysis, as well as the collection of 31 rocks samples for whole-rock litho geochemistry, 95 rock samples for petrography, and 25 rock samples for geochronology.

Fixed loop electromagnetic (EM) surveys were conducted by Abitibi Geophysics over several conductors identified from 2020 VTEM data. The ground EM survey consisted of nine loops with measurements taken at 164-foot intervals along 656-foot spaced lines. Depending on the nature of the conductor and the terrain, measurements were taken either out-of-loop or both in-loop and out-of-loop. A total distance of 36.75-line miles was surveyed at 3 prospects over 46 days.

### **Amblor Mineral Belt Extensions**

Trilogy Metals Inc. expanded its footprint in the Amblor VMS Belt in 2021 by staking three blocks of claims outside of the Upper Kobuk Mineral Projects (UKMP). No work was reported in 2022 for the West Kobuk, Helpmejack, and Malamute claimblocks.

### **Chandalar District**

Goldrich Mining Co. did not conduct fieldwork on the Chandalar gold property during 2022. The Little Squaw Creek placer deposit has a measured and indicated resource of 138,000 ounces of placer gold, totaling 120,000 ounces of refined gold, as well as an inferred resource of 19,000 ounces of placer gold, totaling 17,000 ounces of refined gold. The measured and indicated gold resource grades 0.0285 ounces per bank cubic yard. Placer gold from Little Squaw Creek deposits has historically averaged 840 fineness.

### **Wiseman West and East Projects**

Doyon, Limited, is the landowner for a substantial part of the Koyukuk Mining District. Previous work by Bear Creek Mining Company in the 1960s and 1970s discovered multiple copper bearing skarn and porphyry prospects throughout the district. Mine Discovery Fund (MDF) secured the rights to explore Doyon's lands in the eastern portion of the Koyukuk Mining District in 2022. MDF then formed Wiseman Metals to undertake exploration on the land. Wiseman Metals also acquired exploration land as part of their Wiseman West project, with the Dalton Highway separating the project areas.

The 2022 field season included soil sampling, field mapping, reverse-circulation (RC) drilling and airborne and IP geophysics. The field mapping and RC drilling was focused on the Venus and Evelyn Lee prospects, while soil sampling was undertaken at the Luna, Ginger, Hurricane, Evelyn Lee, and Venus prospects. Petrographic analysis of the RC drilling and mapping samples was also conducted. A district scale airborne magnetic and radiometric survey was flown in the summer of 2022.

Selected analyses of skarn samples from Wiseman East prospects include 25.3 percent copper, 0.11 ounces of gold per ton, and 1.41 ounces of silver per ton; and 6.13 percent copper, 0.21 ounces of gold per ton, and 1.94 ounces of silver per ton. The first phase of reconnaissance drilling in 2022 intercepted broad zones of porphyry hosted mineralization open in all directions as well as multiple skarn mineralized zones highlighted with 40 feet grading 0.7 percent copper, 0.24 ounces of silver per ton, and 0.012 ounces of gold per ton. Multiple 3- to 7-mile long mineralized trends have been identified through geochemistry, geophysics, and reconnaissance drilling.

### **Western Region Graphite Creek**

The advanced-exploration stage Graphite Creek project, located 34 miles north of Nome,

hosts the United States' largest large-flake graphite deposit. The graphite-bearing schists are well-exposed and coherent for a strike length of at least 3.1 miles along the north flank of the Kigluaik Mountains gneiss dome, south of the range-bounding Kigluaik Fault. The graphitic rocks are coincident with a 10-mile long electromagnetic anomaly.

Graphite One Inc expanded the Graphite Creek camp from 24-person capacity to 60-person capacity. An additional 24-person camp was established in Nome where the core logging and sample processing facilities were established in 2021.

Graphite One's field program included infill and step-out core drilling in the resource area. Additional core and sonic drilling were completed for geotechnical data collection at the proposed mill site, planned dry tailings, waste rock storage areas and the access route.

Drilling began on June 15 and was completed on September 1, with a total of 6,859 feet of core collected. Core drilling in the deposit area continued to encounter visible graphitic mineralization over wide intervals consistent with previous drilling. A total of 40,590 feet of resource drilling has been conducted through 2022, with drill holes spanning a lateral distance of 4.2 miles.

Environmental baseline data were collected from all the streams in the area. Hydrology and hydrogeology data were collected.

Graphite One released its pre-feasibility study (PFS) in October 2022, a year later than initially anticipated due to COVID-19 setbacks. The study, conducted on an approximately 0.4 square mile area, representing 7 percent of the 10-mile long geophysical anomaly, found that the modeled mine had an annual production potential of 83,000 tons, an increase from the 55,000 tons Graphite One predicted ahead of the study.

According to the PFS, graphite will be mined from the deposit, then crushed, ground,

and concentrated in a processing plant using flotation to enrich the graphite concentrate to approximately 95 percent purity for shipment. The bagged concentrate will then be loaded into 20-foot standard shipping containers and barged to the secondary treatment plant at an undefined site in Washington State. The graphite concentrate would be upgraded to advanced graphite materials at a company-owned processing and recycling facility.

Washington State offers Graphite One the opportunity to use hydroelectric power, a green energy source, to manufacture a green energy material. The Washington plant will upgrade Graphite Creek concentrates, along with purchased graphite material, into 54,700 tons of spherical coated graphite that serves as the anode material in lithium-ion batteries and 28,000 tons of other advanced graphite products per year.

The project shows a post-tax net present value of \$1.36 billion and an internal rate of return of 22 percent. With the positive results of the PFS, work began on collecting information for the feasibility study. It is anticipated that 2 years' work will be required to complete the feasibility study.

The mineral resources and a mineral reserve were updated for the Graphite Creek deposit as part of the PFS. The Graphite Creek deposit, at a 2 percent cut-off grade, contains a measured resource of 5.15 million tons at 5.83 percent graphite, an indicated resource of 30.71 million tons at 5.15 percent graphite, and an inferred resource of 280.65 million tons at 5.11 percent graphite. Proven reserves are 4.20 million tons at 6.0 percent graphite and probable reserves are 20.58 million tons at 5.5 percent graphite. Measured and indicated resources and proven and probable reserves total 6.54 billion pounds of graphite.

The new mineral reserves would support 26 years of mining at the production rates outlined in the study. The inferred resources that lie immediately northeast and southwest of these

reserves would support more than 250 years of additional mining at the production rates outlined in the PFS.

### Illinois Creek

Western Alaska Minerals Corp. continued exploration of the Illinois Creek property located 55 miles south of Galena. The Illinois Creek property hosts the past-producing Illinois Creek Mine, the Round Top copper porphyry prospect, the Waterpump Creek carbonate-replacement prospect, the Honker gold prospect, and other prospects. The Illinois Creek deposit is estimated to contain 8.2 million tons of mineral resources in the indicated category at a grade of 0.03 ounces of gold per ton and 0.96 ounces of silver per ton plus 3.4 million tons of mineral resources in the inferred category at an average grade of 0.03 ounces of gold per ton and 1.05 ounces of silver per ton (app. D).

Western Alaska Minerals drilled 28 holes totaling 23,483 feet at the Waterpump Creek prospect deposit to define and extend the high-grade silver-lead-zinc mineralization encountered during 2021 drilling. Nine drillholes intersected

carbonate-replacement deposit style sulfide mineralization that is modeled to form a 100 to 250-foot wide and 1,300-foot long manto body that plunges to the south and remains open to the south. Significant drill interceptions are listed in table 9. The mineralization affects reactive dolomite lying beneath an impermeable schist along the Waterpump Creek structure. Hole WPC22-18 tested the intersection of the Waterpump Creek and Illinois Creek structures and cut 326.5 feet of massive and semi-massive sulfides interpreted to reflect a “feeder chimney” and a possible mineralizing fluid upwelling zone. Multiple stages of sulfide mineralization are indicated, with lead-silver dominant galena rich zones cutting earlier zinc-dominant sphalerite rich zones and late-stage pyritic zones cutting the earlier silver and base metal zones.

A Controlled Source Audio- Magnetotelluric (CSAMT) geophysical survey was completed over the Illinois Creek, Waterpump, and Last Hurrah prospects. The 11-line, 35 line-mile survey was used for inversion modeling and re-interpretation of the property-wide geology. Three exploration drill holes totaling 4,523 feet tested possible

**Table 9.** 2022 Significant Illinois Creek project drilling results

[opt = grade of silver in troy ounces of silver per ton]

Hole Number	From (ft)	To (ft)	Interval (ft)	Grade Ag (opt)	Grade Zn (%)	Grade Pb (%)
WPC22-07	437.8	457.4	19.6	14.69	12.1	14.8
WPC22-07	481.8	527.7	45.9	1.73	10.3	1.9
WPC22-08	367.9	402.9	35.0	5.02	9.9	6.4
WPC22-11	446.5	483.4	36.9	10.78	16.7	10.0
WPC22-11	490.2	501.7	11.6	4.83	22.3	5.1
WPC22-13	481.8	490.8	9.0	41.73	2.5	37.1
WPC22-13	508.5	516.2	7.7	26.24	15.0	13.0
WPC22-17	402.9	559.5	156.6	4.61	9.0	5.5
WPC22-18	472.5	799.0	326.5	13.70	5.4	5.3
WPC22-20	534.8	571.4	36.6	13.34	14.8	10.9
WPC22-20	594.5	660.9	66.4	5.12	9.4	5.8
WPC22-21	481.5	497.9	16.4	11.17	14.9	22.0
WPC22-22	518.7	591.6	72.9	11.46	9.0	20.3
WPC22-22	664.5	695.0	30.5	10.72	3.5	8.7

extensions of the Illinois Creek deposit outlined by the CSAMT survey. Drillholes IC22-01 and IC22-02 intersected intense silicification, brecciation and pyrite mineralization. Drillhole IC22-03 intersected some alteration. Another drillhole tested mineralization at the Last Hurrah prospect, but results were not announced.

Western Alaska Minerals added to their land package, with 18 Alaska state mining claims added at the Pawprint property, 16 claims added to the Khotol property and an additional 115 claims staked at the Illinois Creek property. They also collected 643 soil samples throughout the district.

### **Hog River**

Taiga Mining Company, Inc. completed geological and geophysical exploration on their claims in the Hogatza River area. Work included placer exploration drilling of at least 330 holes, prospect holes, and trenching.

### **Lost River**

Greatland Exploration Ltd. leased rights to the Lost River lode area to Lost River Mining Inc., a private company. Up to 17 people were on site during the summer based out of a small camp. Fieldwork included relogging and sampling of historical core and mapping of the claim area. The work also involved 7,000 of test drilling within a previously defined orebody, estimated at 38 million tons, to redefine the tin and tungsten resource and reassess the feasibility of mining by modern methods.

### **Hannum Creek**

NANA conducted a ground-based IP geophysical survey over the target area.

## **Eastern Interior Fairbanks District Fort Knox**

Exploration continued at Kinross Gold Corporation's Fort Knox Mine 20 miles north of Fairbanks. Fairbanks Gold Mining Inc., a wholly owned subsidiary of Kinross, conducted exploration in the Fort Knox pit and in the

surrounding area within the Fort Knox upland mining leases. Exploration drilling continued on the western and eastern sides of the Fort Knox pit. Exploration tested early-stage targets developed from gravity survey data in the Fairbanks Mining District.

Resource definition drilling at the Gil-Sourdough deposit sought to convert and upgrade inferred resources to mineral reserves within the scoping-level pit design. Results were not announced.

Exploration focused on testing deep, higher grade ore-shear extensions beyond the Fort Knox Phase 9 pit design. Drilling proved that high-grade mineralization extends 1,000 feet outside the current life of mine pit along the Dandelion Ore Shear. Drillhole FFC22-1851 had a 25-foot intercept grading 0.132 ounces of gold per ton, including a 6.6-foot interval grading 0.489 ounces of gold per ton. Additionally, exploration sampled geotechnical and other holes which also yielded significant, but unannounced, results.

### **Amanita**

Avidian Gold's Amanita property lies approximately 4 miles southwest of the Fort Knox Mine. No work was completed in 2022.

### **Golden Summit**

Freegold Ventures Ltd. continued an aggressive exploration drilling program at its intrusion-related Golden Summit property approximately 5 miles north of the Fort Knox Mine near Fairbanks (photo 2). Freegold previously defined a bulk-tonnage resource of 2.9 million ounces of gold (app. D) associated with the Dolphin intrusion, and the company completed a preliminary economic assessment (PEA) of the project in 2016.

Mineralization at Golden Summit occurs in three main forms: a) intrusion-hosted quartz-sulfide stockwork veinlets (such as the Dolphin prospect); b) auriferous quartz-sulfide veins (historical underground mines); and c) shear-hosted gold-bearing veinlets. All three mineralization forms are part of a



**Photo 2.** More than 275,000 feet of drilling has been completed on the Golden Summit property since 2020. Photo courtesy of Freegold Ventures Ltd.

large-scale intrusion-related gold system on the property, with the Dolphin intrusion as the apparent mineralization source. The drilling program continued to test the vein swarm system, consisting of multiple veins, veinlets and stockwork zones within areas of intense silicification and alteration, extending from the area of the old Cleary Hill Mine workings towards the Dolphin intrusion.

Since 2020, Freegold completed over 275,000 feet of drilling, representing the most concerted exploration effort ever undertaken on the Golden Summit project. The drill program focused exclusively on the Dolphin Cleary zone and has extended gold mineralization over 1 mile along strike and to depths of over 3,300 feet. A total of 113,743 feet were drilled in 44 holes during the 2022 field season. Table 10 tabulates

some of the significant drill intercepts from the 2022 Golden Summit drill program.

The Dolphin Cleary zone is the only area of the project to have a delineated resource. The deposit remains open, particularly to the west and southwest, where Freegold outlined a strong gold in soil geochemical anomaly that has not been drill tested. Further southwest lies the historical Newsboy Mine, which produced 40,000 ounces at an average grade of 1 ounce of gold per ton.

Several lines of controlled source audio magnetotellurics (CSAMT) geophysics were completed aimed at outlining broader silicified zones. Preliminary 3D modeling defined large high resistivity features proximal to known vein occurrences.

An initial test natural source audio magnetotellurics (NSAMT) survey was undertaken over the core of the Dolphin Cleary zone. Preliminary 3D results complement the known geology very well. The survey was expanded beyond the known mineralization to generate other targets for the 2023 program.

Additional geophysics was completed at the Saddle zone, which lies 2.5 miles east of the Dolphin Cleary zone. The Saddle zone is comprised of a series of narrow veins that correlate well with strong gold in soil geochemistry. The Saddle zone hosts a past high-grade gold producer, the American Eagle Mine, with production of 60,000 ounces at 1.6 ounces of gold per ton.

To the north of the central Dolphin Cleary zone, 527 soil samples were collected over a broadly spaced grid. This sampling is the first program undertaken in that area since Freegold acquired the property in early 2022.

### **Grant-Ester**

Felix Gold Ltd. acquired the Grant Ester property in 2021. Felix Gold calculated a gold resource for the Grant Mine based on historical data that is compliant with the Australia Joint Ore Reserves Committee (JORC) standards. The Grant Mine contains an Inferred Mineral

**Table 10.** 2022 Significant Golden Summit project drilling results. Interval refers to drill hole intercepts. True width cannot be determined due to the uncertain geometry of mineralization. Au (opt) is the grade of the interval in ounces of gold per ton

Zone	Hole Number	From (ft)	To (ft)	Interval (ft)	Au (opt)
Dolphin	GS2208	873.7	948.5	174.5	0.051
Dolphin	GS2209	220.5	272.3	51.8	0.070
Dolphin	GS2209	538.1	607.0	68.9	0.053
Dolphin	GS2209	1374.7	1786.4	411.7	0.037
Dolphin	GS2211	1897.0	1997.0	100.1	0.040
Dolphin	GS2212	1024.3	1382.9	358.6	0.048
Cleary	GS2214	402.9	545.3	142.4	0.063
Cleary	GS2214	1511.5	1581.4	69.9	0.074
Dolphin	GS2215	957.0	2171.3	1214.2	0.050
Dolphin	GS2216	1697.8	1868.8	170.9	0.036
Dolphin	GS2217	2336.9	2524.6	187.7	0.077
Cleary	GS2218	1173.6	1280.8	107.3	0.073
Dolphin	GS2220	443.6	503.6	60.0	0.058
Dolphin/Tolovana	GS2221	966.9	2347.1	1380.2	0.040
Dolphin	GS2225	849.7	1892.4	1042.7	0.042
Dolphin	GS2226	2217.5	2280.2	62.7	0.040
Dolphin	GS2228	1157.2	1499.0	341.9	0.036
Cleary	GS2229	1876.6	2171.9	295.3	0.037
Dolphin	GS2230	2423.9	2844.2	420.3	0.046
Cleary	GS2231	587.3	739.8	152.6	0.062
Dolphin	GS2232	1190.9	1816.9	626.0	0.112
Dolphin	GS2232	2075.5	2295.9	220.5	0.040
Cleary	GS2235	1951.1	2223.8	272.6	0.034
Dolphin	GS2236	1482.0	2057.1	575.1	0.056
Dolphin	GS2241	1742.1	2033.1	291.0	0.042

Resource estimate of 6.4 million tons grading 0.057 ounces of gold per ton for 364,000 ounces of contained gold including an underground resource of 36,000 ounces of gold grading 0.181 ounces of gold per ton (app. D). No work was completed on the project in 2022.

### NE Fairbanks

Felix Gold's NE Fairbanks project consists of consolidated state claims west of Fox, north of the Fort Knox Mine, and south of the Chatanika River. Shallow reverse circulation reconnaissance

drilling was completed to follow-up anomalous gold results from the 2021 soil geochemistry survey at the Coffee and Eureka prospect areas of NE Fairbanks.

At the Coffee prospect, 24 holes were drilled covering a 1.25-mile by 1-mile area. Announced drilling results were highlighted by holes 22NERC021, with 9.8 feet grading 0.124 ounces of gold per ton, and 22NERC014, with 60 feet grading 0.006 ounces of gold per ton.

Drilling in the Eureka prospect area

consisted of 8 holes covering an area of approximately 0.6 miles by 1.75 miles. Announced results included hole 22NERC028 with 9.8 feet grading 0.046 ounces of gold per ton and hole 22NERC025 with 40 feet grading 0.009 ounces of gold per ton.

### **Treasure Creek**

Felix Gold's Treasure Creek project area consists of consolidated state claims north of Old Murphy Dome Road that include the Northwest Array, East Gate, Scrafford Shear, and Wild Cat zones. A soil sampling program carried out in 2021 identified the Northwest Array, Scrafford Shear, and East Gate zones as key targets for 2022 drilling.

Felix Gold completed 183 reverse circulation drill holes totaling 54,803 feet and 4 core holes totaling 3,543 feet in 2022 across all their controlled properties. On the Treasure Creek property, 123 shallow, reverse circulation drill holes were completed to test gold soil geochemical anomalies, geophysical anomalies, and historical drilling.

Drilling at the Northwest Array zone identified a large area of multiple, thick, near surface gold intercepts, especially in the southern area of the zone. Drilling highlights include 95 feet grading 0.041 ounces of gold per ton starting at 80-foot depth in hole 22TCRC002, 110 feet grading 0.048 ounces per ton starting at 5-foot depth in hole 22TCRC005, 295 feet grading 0.035 ounces of gold per ton starting at 105-foot depth in hole 22TCRC008, 125 feet grading 0.032 ounces of gold per ton starting at 5-foot depth in hole 22TCRC071, 115 feet grading 0.053 ounces of gold per ton starting at 55-foot depth in hole 22TCRC075, and 295 feet grading 0.028 ounces of gold per ton starting at 150-foot depth in hole 22TCRC078.

Drilling at the East Gate zone encountered shallow gold mineralization. Drill results included 20 feet grading 0.103 ounces of gold per ton starting at 205-foot depth in hole 22TCRC022, and 20 feet grading 0.118 ounces of gold per ton

starting at 45-foot depth in hole 22TCRC113.

Drillhole 22TCRC039 at the Scrafford Shear zone had a 105-foot intercept grading 0.015 ounces of gold per ton starting at 375-foot depth and a 60-foot intercept grading 0.017 ounces of gold per ton starting at a 495-foot depth. Geological evaluation of the Scrafford mineralization from current drilling updates the current structural model from a single shear to multiple (up to 4) "duplexed" thrust shears.

Four oriented diamond holes were drilled at the Northwest Array and East Gate areas. These holes tested the depth of mineralization encountered with the reverse circulation drilling, as well as new induced polarization geophysical targets at the East Gate zone. Detailed structural observations from the diamond drilling program were used in geological modeling.

Felix Gold flew a virtual time domain electromagnetic (VTEM) airborne geophysical survey over the Treasure Creek area to complement a previously flown magnetic survey.

### **MTH Project**

Felix Gold conducted an initial reconnaissance drilling program to test gold mineralized structures. Eleven drill holes tested a strike length of approximately 1 mile across the southern and eastern portions of the property. Significant drilling results include holes 22NERC041, with 5 feet grading 0.121 ounces of gold per ton, and 22NERC46, with 5 feet grading 0.032 ounces of gold per ton and 5 feet grading 0.071 ounces of gold per ton.

Drilling at the Old Glory prospect identified an anomalous gold mineralized zone of approximately 300 feet by 1,600 feet, highlighted by hole 22NERC033 with 30 feet grading 0.033 ounces of gold per ton and hole 22NERC037 with 20 feet grading 0.033 ounces of gold per ton. To support future drilling plan design, Felix Gold planned target refinement with the incorporation of the recently completed heliborne magnetic and VTEM geophysical surveys.

## Bonnifield District

### Liberty Bell

Felix Gold did not conduct any field work in the Liberty Bell area during 2022.

### Usibelli

Usibelli Coal Mine Inc. drilled 13 holes of 4-inch core totaling 2,000 feet through mineable coal seams at the Usibelli Coal Mine near Healy. The exploration program was designed as part of an ongoing study of possible extraction of critical minerals and rare earth elements from coal and coal ash. Usibelli analyzed the core with a geochemical package that included critical minerals and rare earth elements, as well as standard proximate and ultimate analysis. These analyses and handheld X-Ray Fluorescence analysis will be compared against previously gathered geochemistry from 2020 and 2021. The data will inform future, targeted rare earth element sampling and compositing protocols in addition to development drilling and analysis. The exploration program was conducted in partnership with the Alaska Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) program, as part of the U.S. Department of Energy's CORE-CM Program.

### Circle District

Great American Minerals Exploration, Inc. continued limited exploration on their large claim holdings in the Circle Mining District. Work included drone photography over the Switch Creek and Mastodon Dome target areas, and permit reviews.

## Goodpaster District

### Pogo

Northern Star Resources Ltd. continued exploration activities across the Pogo property centered on the Pogo Mine, 38 miles northeast of Delta Junction. At the end of 2022, Pogo had a total of 7.3 million ounces of gold resources (app. D).

The Pogo deposit includes six underground gold deposits related to an intrusion-related gold system. The Liese vein system consists of

at least four stacked, flat to moderately dipping quartz veins. The South Pogo, Fun, and Central zones are direct extensions of the Liese veins. The North zone consists of a series of steep northeasterly-dipping sheared quartz veins, while the East Deep zone is similar in strike and dip to the Liese vein system, although it has higher sulfide content and thinner quartz veins. Gold is most often associated with disseminated sulfides or sulfide veinlets within quartz veins. Gold at Pogo is predominantly hosted within laminated quartz veins ranging in thickness from less than 0.5 meters to greater than 10 meters. Mineralized veins contain around 3 percent sulfides (arsenopyrite, pyrite, pyrrhotite, loellingite, chalcopyrite, bismuthinite, sphalerite, galena, molybdenite, tetradymite, maldonite) and a variety of bismuth-lead-silver sulfosalts.

Surface exploration activity concentrated on resource definition drilling programs at the Central Gap prospect. Other key regional prospects include Hill 4021, Burn, Cholla, and Stone Boy.

Several new underground diamond drill platforms were built in 2022 to facilitate drilling possible extensions of the North zone. Drilling successfully extended the high-grade gold mineralization within a set of stacked, steeply dipping vein structures. Significant drill results are shown in table 11.

Drilling in the South Pogo zone focused on the gap between South Pogo zone and the upper areas of the Liese vein system. Multiple, stacked high-grade Liese style quartz veins have been intersected in the prospective paragneiss host sequence. Significant drill results are listed in table 11.

### Goodpaster

The Goodpaster deposit is approximately 1.25 miles west of the Pogo Mine, along the Goodpaster trend. The Goodpaster mineralized vein system has been delineated over a 1.2-mile strike length and remains open in every direction. Drilling confirmed the geological model of

**Table 11.** 2022 Significant Northern Star Pogo area drilling results (all widths are estimated true width)  
[Au (opt) = troy ounces of gold per ton]

Area	Hole Number	True Width (ft)	Au (opt)
North Zone	22U0440	7.5	0.744
North Zone	22U0434	2.0	3.450
North Zone	22U0479	2.0	4.859
North Zone	22U0822	7.5	1.213
North Zone	22U0432	15.4	0.280
North Zone	unknown	19.4	1.651
North Zone	unknown	5.9	0.572
South Pogo	22U0774	6.6	1.286
South Pogo	22U0772	16.4	0.467
South Pogo	22U0783	13.5	0.283
South Pogo	22U0789	17.4	0.268
South Pogo	22U0786	10.5	0.236
Goodpaster	DH22-006	9.8	0.487
Goodpaster	DH22-008	1.0	2.584
Goodpaster	DH22-009	2.0	1.129
Goodpaster	DH22-010	3.9	0.855

shallow to moderate, northwesterly-dipping shear zones containing stacked quartz vein structures, combined with several strike-extensive zones of sub-vertical quartz veining. This structural style and characteristic gold-bismuth-telluride mineralization are comparable to the Fun zone at the Pogo deposit.

A resource definition drilling program was completed at the Goodpaster project. The program delivered a maiden underground Inferred Mineral Resource estimate, based on 214 diamond drill holes, of 3.5 million tons grading 0.330 ounces of gold per ton, for 1.1 million ounces of gold.

Surface exploration drilling continued to expand the limits of the Goodpaster mineralized system beyond the maiden underground resource.

Gold mineralization was encountered up to 1,100 feet on strike and down-dip from the maiden resource area. Significant drill intersections are listed in table 11. Targeted infill drilling also confirmed the continuity of several steeply dipping vein systems that are largely excluded from the recent resource volume. Results will be used to update the Goodpaster geological model and guide further exploration drilling. An updated resource estimate is expected in 2023.

### Star

The Star prospect is located 1 mile southeast of the Pogo Mine. Gold mineralization is present in a quartz-sulfide-gold vein system developed in the hanging wall of the moderately northwest-dipping Star shear zone. The mineralized shear zone was discovered during the end of the 2022 summer drilling exploration program. The mineralized quartz vein structures are characterized by a quartz-bismuth-telluride-arsenopyrite-gold infill assemblage. The host rock consists of sheared paragneiss.

The discovery hole (22-036) intercepted a 31.8-foot quartz-sulfide-gold vein at a downhole depth of 1,706 feet with a composite grade of 1.543 ounces of gold per ton. Visible gold is fine grained but abundant throughout the vein.

Drill hole 22-036 was designed to target a prominent lidar lineament that wrapped around topography, revealing a shallow northwest dip that was consistent with large veins at the mine. Surface geochemistry along the lineament did not find any significant gold or pathfinder anomalies. The mineralized shear zone was a conceptual target, and hole 22-036 was the first hole drilled into the shear zone.

Follow-up drilling in the fall and winter of 2022 intercepted the Star shear zone in all 7 holes. DDH 22-044, the last hole drilled in 2022, intercepted a 22.6-foot quartz-sulfide shear vein with a composite grade of 0.385 ounces of gold per ton.

### 64North

The 64North Gold project is a joint venture

of Millrock Resources Inc. and Resolution Minerals Ltd. formed to explore claims adjoining Northern Star Resources' Pogo property.

Resolution completed a 5-hole, 7,655-foot, core drilling program at Tourmaline Ridge, a 64North gold prospect about 3 miles west of the Northern Star's Pogo Mine. The Tourmaline Ridge prospect covers a 6,000-foot by 2,550-foot area outlined by anomalous soil sampling results. Four holes intersected gold mineralization, with the best intersection of 3.3 feet grading 0.195 ounces of gold per ton from hole 22TR005. Hole 22TR003 had a 1-foot interception grading 0.134 ounces of gold per ton, and hole 22TR002 had a 23-foot intersection grading 0.032 ounces of gold per ton. Resolution noted anomalous gold associated with brecciated orthogneiss and sulfide-bearing quartz veins.

Extremely Low Frequency Electromagnetic (ELF-EM) ground geophysical lines totaling 17.5 line-miles were completed across several properties within the project area. Ground penetrating radar covering 5.5 line-miles was also completed.

Work on the East Pogo block was conducted at the Miranda prospect. Resolution collected 87 soil samples over a small grid. Results showed a northeast-trending linear anomaly. Four ELF-EM lines were completed and used to modify the existing geological model.

Work at the George prospect in the Divide block included one ELF-EM line, geological mapping, and rock sampling. Resolution interpreted results to be consistent with porphyry style copper-gold-molybdenum-silver mineralization.

ELF-EM surveys were also conducted at the East Pogo, Last Chance, and California North prospects. Results were mixed, indicating need for further work.

### **Tibbs**

After a large 2021 program, Tectonic Metals, Inc. did not conduct exploration at their Tibbs gold project 22 miles east of the Pogo Mine.

Mineralization at the Tibbs project comprises high-grade, near-surface gold hosted by both high- and low-angle quartz–pyrite–arsenopyrite–stibnite veins and sheeted-to-stockwork quartz–sulfide veins.

### **Carrie Creek/Tibbs South**

Tectonic Metals Inc. reviewed results from their 2021 exploration program conducted on the Carrie Creek property leased from Doyon Ltd. Tectonic also completed a brief three-day field program to follow-up on the 2021 Jorts prospect drilling with additional surface sampling, conducted reconnaissance geological examination of the North “Jackie Block” and completed reclamation of 9 of the 2021 reverse circulation drillholes drilled at the Jorts and Jeans prospects.

### **Maple Leaf**

During 2022, Tectonic Metals Inc. discontinued the Maple Leaf gold project adjacent to the Tibbs property.

### **Mt. Harper**

Tectonic Metals Inc. reviewed results from their 2021 exploration program conducted on the Mt. Harper property.

### **Healy Claims**

Kenorlands Minerals Ltd., in joint venture with Newmont Corp., explored the Healy gold property located 29 miles southeast of the Pogo Mine. Mineralization styles at the Healy property are disseminated sulfide, quartz-carbonate vein-hosted sulfide, and breccia-fill sulfide including arsenopyrite, pyrite, and stibnite with rare sphalerite. Pervasive alteration is dominantly sericite, carbonate with lesser fuchsite associated with structural features. Geochemical associations of gold with silver, antimony and arsenic at the Bronk, Thor, and Spike prospects are interpreted to indicate an overall distal intrusion-related setting for the Healy gold system in a package of metamorphic rocks.

No field work was completed during the 2022 exploration season. Further data compilation and analysis was conducted throughout the year with the goal of gaining

further understanding of the geology and controls on mineralization at the Bronk and Thor targets.

## **Richardson Subdistrict**

### **SAM**

Great American Minerals Exploration, Inc. continued a joint venture with Koza Ltd. (USA) Inc. (operator and majority interest) at the SAM gold project in the Richardson mining subdistrict between Fairbanks and Delta Junction. According to a 2021 update, the Naosi deposit hosts an indicated resource of 997,000 ounces of gold at an average grade of 0.054 ounces of gold per ton and an inferred mineral resource of 575,000 ounces of gold at an average grade of 0.034 ounces of gold per ton. An estimated 1,075,000 ounces of the total resource are in oxidized rock, with the balance in refractory sulfide-bearing rock (app. D). The resource also includes 22 million ounces of silver. A preliminary economic assessment for the Naosi deposit is in progress.

### **Shamrock**

The Shamrock property in the Richardson Mining District near Salcha was staked by Contango ORE Inc. in March 2021. No work was completed in 2022 on the Shamrock property.

## **Tolovana District**

### **Livengood**

International Tower Hill Mines Ltd.'s (ITH) Livengood gold project is an advanced-exploration-stage, intrusion-related gold deposit located 75 road-miles northwest of Fairbanks. The Money Knob deposit at Livengood hosts a gold resource estimated at 13.62 million ounces, consisting of 776.6 million tons of measured and indicated resources averaging 0.018 ounces of gold per ton. Proven and probable mineral reserves total 430.1 million metric tons at an average grade of 0.019 ounces of gold per ton (9.0 million ounces contained) (app. D).

ITH completed a Technical Report Summary for the Livengood project in early 2022 and approved a 2022 budget of \$3.2 million. The 2022 work program advanced the

baseline environmental data collection in critical areas of hydrology and waste rock geochemical characterization needed to support future permitting. In 2022, metallurgical analyses of drill samples were completed and community engagement conducted.

### **Shorty Creek**

The Shorty Creek prospect is an intrusion-related, copper–gold–silver–tungsten property approximately 75 road-miles northwest of Fairbanks. For several years South32 Ltd. funded a joint venture agreement to explore Freegold Ventures Limited's property. In 2022, South32 provided notice of its intention and election not to fund any further tranche payments as defined in the option agreement. Accordingly, the option agreement was terminated. No work was completed on the property in 2022.

### **McCord Gold**

Endurance Gold Corporation continued holding claims in the McCord Creek area near Livengood. No exploration work was conducted during 2022.

### **Elephant Mountain**

Endurance Gold Corp. did not conduct any work in 2022 on the Elephant property. Endurance also continued its option on the nearby Trout and Wolverine properties. No work was conducted during 2022.

### **Kaazene**

Wiseman Metals acquired property in the Tofty Tin Belt that is prospective for carbonatite-hosted rare earth elements. No additional work was announced.

## **Tok District**

### **Manh Choh**

Kinross Gold Corp. and Contango ORE Inc. continued the 70/30 Peak Gold JV work on the Manh Choh gold–silver project, located on land leased from the Native village of Tetlin 11 miles south of Tok. The joint venture intends to develop the project by trucking the ore 250 miles to the Fort Knox mill in Fairbanks. The skarn

deposit hosts measured, indicated, and inferred resources of 0.927 million ounces of gold at an average grade of 0.115 ounces of gold per ton and 3.4 million ounces of silver at an average grade of 0.423 ounces of silver per ton (app. D).

The Peak Gold JV announced an approximate \$26 million budget for 2022. The work program included completion of a feasibility study, and continuation of the federal and state permitting process, environmental monitoring, community engagement, engineering, early construction, and exploration. More information on non-exploration work is given in the Development and Production section of this report.

Exploration was conducted in the Chief Danny area, with 223 rock samples, 518 soil samples, and 607 stream silt samples collected. A gravity geophysical survey was completed. A 9-hole drilling program totaling 6,493 feet was completed at the North-East, Discovery, and Ridgeline targets in the Chief Danny area.

Extensive regional reconnaissance was conducted at the greater Tetlin lease area. The sampling program included 584 stream sediment samples, 1,682 soil samples, and 450 rock samples. Results generated several areas of interest for future work.

### **Eagle-Hona**

Contango Ore Inc.'s Eagle-Hona claims northwest of the Manh Choh property cover a 6-mile long northwestern-trending corridor in which every creek draining the northeast slopes of the mountains showed strongly anomalous gold, arsenic, and copper. No work was completed in 2022.

### **Seventymile**

Tectonic Metals, Inc. completed a drilling program in 2022 at its Seventymile shear-zone-hosted gold project, located 40 miles west of Eagle. The project includes the Flanders, Alder Creek, and Bonanza Creek lode prospects and is leased from underlying landowner Doyon, Ltd.

Nine reverse circulation drill holes totaling 4,633 feet were completed on the Seventymile property. The drilling was conducted primarily at the Flanders prospect, with wide-spaced drilling targeting analogous stratigraphic-structural settings at the Alder, Bonanza, and Flume prospects. All holes tested for shear related mineralization at the structural contact between the basal Seventymile terrane ultramafic-mafic units and overlying Seventymile terrane iron basalt-tuff assemblage. All holes intersected gold mineralization, including a drill highlight of 1.9 ounces of gold per ton over five feet.

Tectonic relinquished the Seventymile property on Dec 31, 2022.

### **Tanacross**

Kenorland Minerals Ltd.'s Tanacross project comprises a cluster of porphyry-type prospects about 55 miles northeast of Tok, including the Taurus, Bluff, East Dennison, Pushbush, and Big Creek prospects. Kenorland signed an earn-in agreement with Antofagasta Minerals S.A., a wholly owned subsidiary of Antofagasta PLC (ANTO: LSE), on the Tanacross copper-gold project. The agreement grants Antofagasta an option to acquire a 70 percent interest in the project by spending \$30 million on exploration over 8 years and delivering a NI 43-101 compliant preliminary economic assessment report. The agreement included a planned drill program for 2023.

The 2022 field program included various geophysical, geological, and geochemical surveys covering the East Taurus, McCord Creek, West Taurus, and South Taurus target areas. Exploration activities were carried out over two phases: Phase 1 was completed in June 2022, including detailed ground gravity and extremely low frequency electromagnetic (ELF-EM) surveys at the South Taurus target completed by Aurora Geoscience. Phase 2 included a 26 line-mile induced polarization (IP) and magneto-telluric (MT) survey completed at approximately 1,150-foot line-spacing over an area of 2.7 by 2 miles. The survey covered the East Taurus-McCord

Zone-West Taurus complex. Geological mapping and review of historical core was also completed to aid in geophysical interpretations.

Detailed soil sampling was completed at the West Taurus, McCord zone, East Taurus, and South Taurus targets. A total of 773 soil samples were collected between the four targets over 164 by 328-foot grid spacings.

### Golden Zone

Avidian Gold Alaska Inc.'s Golden Zone property, 25 miles southwest of Cantwell and accessed off the Parks Highway, contains numerous igneous-related mineral occurrences over a 9.3-mile strike length. The property's Golden Zone Breccia Pipe deposit has a NI 43-101-compliant resource of 6.1 million tons grading 0.05 ounces of gold per ton and 0.247 ounces of silver per ton, for a total of 303,300 ounces of gold and 1,509,200 ounces of silver (app. D).

In 2022, Avidian personnel conducted a short property visit to review drill core, geology, general camp layout, and facilities conditions with interested parties. Compilation of historical data continued.

Avidian staked an additional 6.5 square miles of ground immediately to the south and southwest of the Golden Zone property to increase its district-scale land holdings to 54.4 square miles. The staked ground fills the gap between the Golden Zone property and Discovery Alaska Limited's Chulitna property.

### Chulitna

Discovery Alaska Ltd. continued exploring the Chulitna project covering gold-silver-copper and tin-silver prospects. The roughly 77 square mile land package includes the Partin Creek and Coal Creek prospects about 4 miles west of the Parks Highway and near the Golden Zone property. No exploration work was undertaken at Partin Creek prospect during 2022.

Discovery Alaska identified lithium at the Coal Creek prospect by examining and analyzing

legacy drill core stored at the Alaska Geologic Material Center. The core was re-logged and a comprehensive work program was conducted to qualify and quantify the lithium (and other critical minerals) occurrences at Coal Creek. The lithium bearing units are also prospective for other critical minerals including tantalum, niobium, and other specialty metals.

Significant lithium results include: 52.5 feet grading 0.19 percent  $\text{Li}_2\text{O}$  starting at 415-foot depth in hole DDH06-43, 36 feet grading 0.18 percent  $\text{Li}_2\text{O}$  starting at 277.9-foot depth in hole DDH06-44, 90.7 feet grading 0.16 percent  $\text{Li}_2\text{O}$  starting at 556.4-foot depth in hole DDH06-43, 195.2 feet grading 0.13 percent  $\text{Li}_2\text{O}$  starting at 551.8-foot depth in hole DDH-33, 180 feet grading 0.12 percent  $\text{Li}_2\text{O}$  starting at 140.0-foot depth in hole DDH-36, 120.0 feet grading 0.12 percent  $\text{Li}_2\text{O}$  starting at 571.8-foot depth in hole DDH06-45, and 188.8 feet grading 0.11 percent  $\text{Li}_2\text{O}$  starting at 464.9-foot depth in hole DDH-21.

The distribution of the new geochemical results indicates significant broad intercepts of lithium-rich zinnwaldite mineralized zones concentrated within the deeper aplitic granite porphyry and separate higher-grade lithium zones potentially localized along structurally controlled zones of east-west striking, near-vertical, sheeted greisen veining.

### Alaska Range Projects

PolarX Ltd.'s Alaska Range projects include the Caribou Dome property and the Stellar property covering several copper- and gold-bearing deposits and prospects accessed from the Denali Highway between Paxson and Cantwell. These include the sediment-hosted-copper Caribou Dome deposit (3.1 million tons grading 3.1 percent copper; app. D), the Zackly gold-copper skarn deposit (3.75 million tons grading 1.2 percent copper, 0.058 ounces of gold per ton, and 0.409 ounces of silver per ton; app. D), and the Saturn, Jupiter, Mars, and Gemini porphyry copper-gold-molybdenum targets.

A scoping study was released in October 2022 for the Alaska Ranger copper gold project which evaluated sequential mining and processing options for the high-grade Caribou Dome VMS copper deposit and the nearby Zackly copper-gold-silver skarn deposit. The pre-production capital cost of developing the Zackly and Caribou Dome mines outlined in the scoping study is \$111 million. The modeled operation generates a pre-tax net present value, with a 7 percent discount, of \$72 million, an internal rate of return of 26 percent, and a capital payback period of 2.3 years.

The study identified several key aspects. Sequentially mining the Zackly deposit, followed by mining the Caribou Dome deposit using one plant modified for each deposit is feasible. Mining is best commenced underground at the Zackly deposit and mining at the Caribou Dome deposit would commence as a shallow, high-grade open-pit, prior to underground mining.

Based on the current mineral resources at the Alaska Range projects, the modeled mining operation would produce 77,360 tons of copper, 102,577 ounces of gold, and 799,407 ounces of silver over 6.5 years of mining. The scoping study demonstrated the potential for significant upside for the project economics through successful resource extension drilling at Caribou Dome and Zackly. Additional metallurgical test-work could potentially improve the copper recovery of the Caribou Dome ore and the gold recovery of the Zackly ore.

The mineral resources at the Zackly deposit were updated as part of the scoping study. The Zackly deposit hosts 4.41 million tons grading 1.1 percent copper, 0.047 ounces of gold per ton, and 0.367 ounces of silver per ton. The resource contains 67.7 million pounds of copper, 213,000 ounces of gold, and 1.63 million ounces of silver. The Zackly deposit is open in all directions.

### **Red Mountain**

White Rock Minerals Ltd. continued early-stage exploration for both gold and massive

sulfides at its Red Mountain project in the northern Alaska Range in 2022. The property hosts an array of zinc-lead-copper-silver-gold-bearing VMS deposits and prospects, with the best known being the Dry Creek deposit (2.6 million tons; app. D) and the West Tundra Flats deposit (7.4 million tons; app. D). The property also contains the Last Chance prospect, a newly defined gold target with gold-arsenic-antimony-bearing quartz-cemented breccias and veins.

White Rock updated the mineral resources on the Red Mountain property using the 12 core holes drilled in 2021. The inferred mineral resource estimate for the Dry Creek Main deposit, the West Tundra Flats deposit, and the Dry Creek Copper zone total 23.5 million tons grading 3.9 percent zinc, 1.6 percent lead, 0.1 percent copper, 2.85 ounces of silver per ton and 0.019 ounces of gold per ton. The inferred resources contain 906,000 tons of zinc, 368,000 tons of lead, 34,000 tons of copper, 60.9 million ounces of silver, and 442,000 ounces of gold. The new mineral resources represent a 27 percent increase in tonnage from previous estimates. White Rock believes considerable upside remains and plans to undertake more drilling to test the Kiwi and other targets.

### **White Gold Project**

White Rock Minerals staked a contiguous block of mining claims across eight high-grade gold prospects in the Alaska Range that form the White Gold project. The gold prospects, including the Goldberg, Shalosky, Low and Hunter prospects, were discovered by American Copper & Nickel Company, with Grayd Resource Corporation, Placer Dome Inc., and Rhyolite Resources conducting exploration campaigns through 2011. The previous work included trenching and approximately 13,000 feet of core drilling. White Rock is currently undertaking a full compilation and desktop review of the historical exploration data to identify the best targets with the potential for a significant high-grade gold deposit.

## Glory Creek

Great American Minerals Exploration, Inc. conducted work on the Glory Creek project in the East Bonnifield district. They compiled and reviewed historical exploration data and prepared a technical report on the prospect.

## Valdez Creek Lode

The Valdez Creek gold lode prospects lie in the headwaters of the Valdez Creek placer deposits in the south-central Alaska Range. Historical exploration identified five vertically stacked, gold-bearing zones over a vertical distance of 600 feet with a strike length of over 900 feet. The claims are currently being explored by Valdez Creek Mining LLC, but no exploration was announced for 2022.

## Delta VMS Project

The Delta mineral belt, approximately 35 miles west of Tok, hosts VMS mineralization with inferred resources totaling 18.8 million tons at average grades of 4.5 percent zinc, 0.6 percent copper, 1.9 percent lead, 1.96 ounces of silver per ton, and 0.048 ounces of gold per ton (app. D). Agnico Eagle (USA) Ltd. did not conduct fieldwork in 2022.

## Napoleon

The Napoleon project is an early-stage, high-grade lode gold prospect in the Fortymile Mining District near Chicken. The prospect was drilled in the late 1990s and early 2000s. J2 Metals Inc. drilled the property in 2021. During the summer of 2022, a project-wide lidar and drone magnetic survey covering 80 percent of the property was completed, with aims of identifying and testing anomalies away from the previously drilled main zone.

## Nikolai/Eureka Zone

The Nikolai project hosts nickel-copper-chromium-cobalt-platinum group element prospects. In total, Millrock Resources Inc's Nikolai project consists of 146 State of Alaska mining claims in two claimblocks covering 36.5 square miles in a highly prospective, underexplored, mineralized ultramafic belt in

the Delta River Mining District. At the Eureka claim block, mineralization, sampled on surface and by drilling, is associated with serpentinized mafic and ultramafic rocks. At the Canwell claim block, surface rock sampling and drilling characterized nickel-copper-platinum group element mineralization associated with mafic and ultramafic dikes/sills. The dikes/sills are hypothesized as deep-rooted feeders to the same ultramafic sills located at the Eureka claims.

Millrock conducted a one-day field visit with a local prospector to review higher-grade prospects on the Canwell claim block. A historical American Copper & Nickel Company drillhole (FL-003) was relogged and resampled from the Eureka Zone to validate low grade mineralization downhole that was originally spot sampled.

Nickel and copper deportment studies and microprobe work was conducted on sample composites from drillhole FL-003. Initial nickel and copper deportment studies completed by Millrock indicate very encouraging results for the recoveries and processing of nickel-sulfide mineralization. Pentlandite accounted for roughly 92 percent of the total nickel content within the Core Eureka Zone composite sample, with roughly 2 percent other nickel sulfides and nickel alloys. Interlocking between pentlandite and pyrrhotite was rarely observed, indicating potential favorable separation processes of pentlandite from pyrrhotite.

Nickel sulfide and nickel alloys accounted for roughly 80 percent of the total nickel within the Upper Eureka Zone composite sample. Pentlandite was the principal nickel-bearing sulfide and carried roughly 64 percent of the total nickel in the Upper Eureka Zone composite. The remaining potentially recoverable nickel was in the form of nickel alloy and nickel metal.

Copper sulfides accounted for 71 percent to 75 percent of the total copper within the Core Eureka Zone and Upper Eureka Zone composites. Chalcopyrite is the dominant copper

sulfide and accounts for 67 percent to 71 percent of the copper in the composite samples. Bornite, chalcocite, cuprite, malachite, and azurite were also present in the composite samples. The remainder of the copper (24 percent to 28 percent) was present in valleriite (copper=iron-magnesium sulphate).

Desktop studies were completed to update the Leapfrog 3D model with newly acquired historical data. Analysis and interpretation of new geological models aided in the planning of a resource definition program for 2023.

## South-Central Region

### Johnson Tract

The Johnson Tract (JT) gold and base-metal deposit is 125 miles southwest of Anchorage. HighGold Mining Inc. is exploring the property under a lease agreement with Cook Inlet Region, Inc. Gold–silver–zinc–copper–lead mineralization is associated with quartz stockworks and hosted in Jurassic volcanoclastic rocks. Mineralization is interpreted to have formed in a sub-seafloor setting contemporaneous with the host stratigraphy, comparable to a volcanogenic massive sulfide deposit, with a possible intermediate sulfidation epithermal deposit overprint. There are at least 9 other altered or mineralized prospect areas over a 7.5-mile strike length.

In early 2020, HighGold announced an initial indicated mineral resource of 2.4 million tons at an average grade of 0.18 ounces of gold per ton, 0.17 ounces of silver per ton, 5.85 percent zinc, 0.57 percent copper, and 0.8 percent lead, for a total 417,000 ounces of gold, or 750,000 ounces “gold-equivalent” when including the other metals (app. D).

An updated mineral resource, including the results from the 88,600 feet of drilling since the maiden resource was completed, was released in 2022. A total of 63 holes were completed at the JT deposit area by HighGold since the initial 2020 resource, including 52 new holes totaling 66,457 feet used in the geologic model and

29 holes totaling 41,680 feet that intersect the resource domains. Additional holes by previous operators along strike to the northeast were also used in generating the new geological model and subsequent resource estimate.

The JT deposit updated resource estimate is based on assay data available as of April 6th, 2022. A total of 120 NQ- and HQ- sized diamond drill holes totaling 139,682 feet were used in generating the geological model for the JT deposit, with 75 holes intersecting the interpreted mineralized zones.

The JT deposit hosts an updated indicated mineral resource of 3.85 million tons grading 0.155 ounces of gold per ton, 0.175 ounces of silver per ton, 0.56 percent copper, 0.67 percent lead, and 5.21 percent zinc. The indicated resource contains 598,000 ounces of gold, 673,000 ounces of silver, 43.1 million pounds of copper, 51.5 million pounds of lead, and 400.8 million pounds of zinc. The inferred mineral resource for the JT deposit is 778,000 tons grading 0.040 ounces of gold per ton, 0.265 ounces of silver per ton, 0.59 percent copper, 0.30 percent lead, and 4.18 percent zinc. The inferred mineral resource contains 31,000 ounces of gold, 207,000 ounces of silver, 9.2 million pounds of copper, 4.7 million pounds of lead, and 65.1 million pounds of silver. The indicated resource is subvertical and averages 131 feet in horizontal width, with an excellent geometry for low-cost mining.

Metallurgical test work was done as part of the resource evaluation program. Metallurgical tests indicate that locked cycle flotation yields very high-quality copper, zinc, lead, and gold concentrates produced at a coarse primary grind, with very good metal recoveries, including 97 percent gold recovery, low impurities, and negligible penalty elements.

The 2022 exploration program focused on the Difficult Creek area, with less work on the Easy Creek, South Valley, and Double Glacier prospects. John Proffett continued mapping and

prospecting north of the JT deposit area toward Kona Creek. An updated property scale geologic map was produced based on the new mapping, combining previous historical maps and ongoing detailed mapping .

During the 2022 field program, 276 rock chip and rock grab samples, and 62 soils samples were collected across the JT deposit, Kona, Difficult Creek, Milkbone and Easy Creek prospects. Re-logging of historical drill core was completed on select drillholes throughout the project. Infill sampling of select drillholes was also completed to fill gaps in the historical database where no previous sampling was completed. A total of 318 infill samples were taken from 12 drillholes throughout the deposit and Difficult Creek areas.

In 2022, Kodiak Mapping, Inc. acquired aerial digital imagery and lidar data along the proposed easement alignment from the JT deposit to Cook Inlet. JT Mining began acid-base accounting work in 2022, with 13 samples of the quartz feldspar porphyritic dacite unit collected from surface and drill core.

Pioneer Exploration Consultants Ltd. completed a 317 line-mile airborne magnetic survey over the Middle Difficult Creek to East Difficult Creek and JT to South Valley corridors to augment a survey that was conducted in 2021. The data shows a magnetic low (magnetite destruction zone) associated with the main JT deposit, bullseye magnetic anomalies at the Kona prospect, and an anomaly associated with a quartz-diorite plug at the Easy Creek prospect.

HighGold completed 57 drillholes totaling 33,945 feet focused on step out drilling at the JT deposit and the Ellis zone, along with further testing of the Central Fault system, other Difficult Creek targets, and new untested targets at the Milkbone prospect.

Five drillholes totaling 8,982 feet infilled and expanded the JT deposit along strike to the northeast. The drilling expanded the mineral resource and filled gaps in the lower grade

inferred resource northeast and down plunge of the main high-grade deposit. Highlights of the drilling are listed in table 12, including a 395.4-foot drill intersection in hole JT22-152 grading 0.547 ounces of gold per ton, 0.55 percent copper, and 3.86 percent zinc.

Drilling totaling 19,870 feet in 43 core holes was completed at the Difficult Creek prospect, including 39 holes at the Ellis zone and 5 holes at other nearby targets. Drillholes at the Ellis zone were completed as fans of holes in a close-spaced, 41 to 164 feet grid pattern. Drilling defined high-grade precious and base metal-rich mineralization over a strike length of 410 feet and from surface to a depth of 738 feet, with an average true thickness of 32 to 49 feet within the plunging core of the zone. Mineralogy, veining, and alteration of the Ellis zone are similar to the main JT deposit.

The Ellis zone drilling expanded the mineralization footprint by nearly 50 percent. Mineralization remains open in all directions. The best drill intercepts from the 2022 drilling program are listed in table 12.

The main Milkbone fault and a smaller oblique splay fault to the east were tested by drilling 6 holes totaling 10,810 feet at the Milkbone prospect. The drilling at both faults encountered altered and mineralized rock and breccia. Drilling highlights are listed in table 12.

A single hole, KN22-003, was drilled at the Kona prospect to test modeled chargeability and conductivity anomalies at depth. No significant mineralization was encountered.

HighGold commissioned an onsite sample preparation facility for crushing and pulverizing drill core samples. The facility significantly reduced assay turn-around time and enabled more efficient follow-up of positive results during the field program.

### **Willow Creek Lucky Shot**

Contango Ore Inc. owns the Lucky Shot

**Table 12.** 2022 Significant Johnson Tract project drilling results

[Opt refers to troy ounces of gold or silver per ton]

Zone	Hole Number	Length (ft)	Cu (%)	Zn (%)	Pb (%)	Ag (opt)	Au (opt)
Ellis	DC22-034	48.23	0.27	4.18	0.75	0.516	0.117
Ellis	DC22-036	140.43	0.21	2.06	0.83	0.680	0.099
Ellis	DC22-043	39.04	0.61	4.20	0.38	0.878	0.632
Ellis	DC22-044	66.60	0.14	1.46	0.18	0.163	0.050
Ellis	DC22-045	115.49	0.12	3.19	1.40	0.178	0.122
Ellis	DC22-046	48.56	0.28	5.97	0.46	0.402	0.296
Ellis	DC22-060	52.82	0.21	3.97	0.19	0.137	0.012
Johnson Tract	JT22-152	395.36	0.55	3.86	0.93	0.180	0.547
	including	32.81	1.06	17.02	2.54	0.525	1.161
	including	62.67	0.27	2.20	0.69	0.175	1.206
Johnson Tract	JT22-148	30.51	0.22	5.57	---	0.000	0.210
Milkbone	MB22-001	4.59	0.14	0.28	0.00	0.000	0.010
Milkbone	MB22-003	4.92	0.01	0.01	0.00	0.017	0.024
Milkbone	MB22-006	22.31	0.08	0.87	0.00	0.000	0.001

property on the north side of Hatcher Pass. The Lucky Shot property includes 725 acres of patented mining claims and 7,865 acres of State of Alaska mining claims covering 3 former producing gold mines in the Willow Mining District. The Coleman, Lucky Shot, and War Baby mines are located along a continuous low-angle structural zone occupied by a series of high-grade quartz veins hosting free gold and minor sulfide and telluride mineralization. Total gold production from the Willow Creek mining district through 1950 is approximately 610,874 troy ounces, making it the third largest historic lode gold producing district in Alaska. Production from the Lucky Shot Mine was reported as 252,000 ounces of gold from 169,000 tons of free-milling ore, with additional production from the Coleman and War Baby mines. A 2016 prefeasibility study estimated measured and indicated resources containing 121,500 ounces of gold (app. D).

Contango established access to the underground workings of the Lucky Shot Mine tunnel to drill the down-dip extensions of the Lucky Shot and Coleman veins. Contango rehabilitated the Enserch portal and the existing 1,380-foot tunnel. This work included

establishing a portal shed and “hardening” surface infrastructure from avalanche potentials. The Enserch tunnel was driven an additional 1,640 feet, including through the Lucky Shot #2 vein. The Enserch tunnel was expanded an additional 757 feet with a western crosscut paralleling the footwall contact of the Lucky Shot #2 vein. The development provided exposure of the Lucky Shot vein for future exploration including provided the beginning of an exploration ramp towards the Coleman ore body structure.

During the advancement of the West drift, an unknown vein was encountered. This vein appears to be a conjugate vein to the Lucky Shot vein system and strikes north and dips to the east. Underground mapping of this vein shows a mineralized thickness between 1 to 3 feet and channel samples of the vein averaged 1.9 ounces of gold per ton.

Contango engaged Atkinson Construction and Major Drilling as contractors to execute the 2022 exploration and development program. Twenty-nine exploration drill holes, totaling 12,500 feet, were completed from the main Enserch tunnel and West drift, with drilling beginning in late June 2022 and ending in November of the same year. All 29 holes

intersected the Lucky Shot vein structure. Contango engaged a third-party structural geologist from Oriented Targeted Solutions Inc. to complete a structural analysis of the vein structure based on underground mapping and drill core logging. Contango anticipates completing an initial resource estimate and then making plans for a follow up program to continue exploration of the Lucky Shot vein structure. Contango expects to initiate a technical study to determine if commercial mining is viable once a sufficient size and quality of mineralized material has been defined.

### **Icy Cape**

Icy Cape is a gold and heavy mineral beach-placer prospect located in the Gulf of Alaska near Icy Bay, about 75 miles northwest of Yakutat. The land is owned by the Alaska Mental Health Trust Authority and managed by the Trust Land Office (TLO). The TLO's Icy Cape Gold and Industrial Heavy Minerals project is a staged, incremental effort to evaluate the potential for producing industrial heavy minerals (garnet, epidote-group minerals, magnetite, ilmenite, zircon, rutile) as part of a placer gold operation.

Resource definition drilling was conducted over a 3-month field season in 2022 at the Grinder prospect. TLO set up a 24-person camp on site and built an additional sample processing facility equipped with state-of-the-art hydrogravimetric core sample processing equipment. The Grinder drill hole plan was based on interpretation of three-dimensional aeromagnetic gradient exploration survey data.

Approximately 10,500 feet of SONIC drilling was completed as part of resource definition drilling. Data from the drilling and sampling program will be used to upgrade the current gold and garnet resource estimate to a NI 43-101-compliant indicated resource status.

### **Genesis (Tonsina)**

No fieldwork was conducted in 2022 at New Age Metals Inc.'s Genesis platinum-group-element-copper-nickel project. The project is

located near Glennallen and consists of chromite-associated platinum and palladium mineralization and stratabound nickel-copper-platinum-group-element mineralization within steeply dipping magmatic layers of the Sheep Hill portion of the Tonsina Ultramafic Complex. Past sampling returned results up to 0.070 ounces of palladium per ton, 0.96 percent nickel, and 0.58 percent copper.

### **Chisna**

No work was conducted in 2022 at Millrock Resources Inc.'s district-scale porphyry copper-gold Chisna project.

### **Canyon Creek**

Flatlands Energy Corporation received a 2-year coal exploration permit. The exploration area covers 8,960 acres of State of Alaska lands west-southwest of the Skwentna airport in the Susitna Coal Basin near Canyon Creek. The permit approved drilling up to 20 new exploration drill holes with helicopter support. Nine holes, totaling 789 feet, were drilled for coal exploration and groundwater monitoring. Four drill holes intersected bedrock and two of those holes contained fractured coal. Six surface water monitoring stations were established. A meteorological station was installed in October 2022 on the exploration site.

## **Southwestern Region**

### **Donlin Gold**

The Donlin Gold project is being explored by Donlin Gold LLC, a 50/50 partnership between Barrick Gold Corp. and NovaGold Resources Inc., on lands owned by Calista Corporation and The Kuskokwim Corporation. The intrusion-related gold deposit contains proven and probable reserves of 34 million ounces of gold at an average grade of 0.06 ounces of gold per ton (app. D) and is one of the world's largest undeveloped gold deposits.

Donlin Gold employed a local workforce of approximately 150 people from 24 Yukon-Kuskokwim communities for the 2022 season. Approximately 70 percent of Donlin Gold direct

hires for the drill program identified as Alaska Native.

In 2022 Donlin Gold invested roughly \$64 million into its third consecutive large drill program, with 141 holes totaling more than 138,890 feet drilled in the Divide, ACMA and Lewis deposit areas. This was the largest drill program on the project since 2006.

The 2022 drilling work targeted resource infilling, deep exploration, expanding understanding of the structural framework and the waste rock facility. Fourteen geotechnical drill holes advanced the Alaska Dam Safety certificate. Results support prior estimates about the size and continuity of the orebody and the upside potential in the area between the ACMA and Lewis pits, where previous drilling had been limited.

Drilling began in late January, and the last drill shut down in the third week of September,

with four drills running for most of that period. Many of the 141 holes drilled in 2022 cut zones of gold mineralization with grades far above the resource average. One of the best holes was DC22-2068, with 138.7 feet of mineralization averaging 0.896 ounces of gold per ton starting at a depth of 385.6 feet. Other notable drill results are listed in table 13.

Much of the additional work focused on a more detailed look at the structure of the Lewis pit. Infill drilling of 43 HQ diameter core holes completed a 33 by 33-foot grid over the Lewis area. Drill hole information will update the geological model. Two 200 by 200-foot trenches were also excavated and mapped to test and improve the geological model.

These 2022 environmental studies included mapping select areas of the Kuskokwim River, establishing new erosion testing areas, and extending and expanding the company's

**Table 13.** Top 20 intercepts from the 2022 Donlin Gold project drilling program

Zone	Hole Number	From (ft)	To (ft)	Interval (ft)	Grade Au (opt)
Divide	DC22-2068	385.56	524.28	138.71	0.896
Divide	DC22-2077	492.49	653.12	160.63	0.602
ACMA	DC22-2040	764.27	935.76	172.47	0.427
Divide	DC22-2063	775.00	975.00	200.00	0.361
Divide	DC22-2063	532.09	596.85	64.76	0.998
ACMA	DC22-2056	327.49	570.21	242.72	0.123
Divide	DC22-2092	380.97	516.11	135.14	0.194
Divide	DC22-2063	426.64	466.34	39.70	0.647
Divide	DC22-2086	527.79	560.30	32.51	0.649
Lewis	DC22-2120	137.34	235.33	98.00	0.203
ACMA	DC22-2040	648.29	709.48	61.19	0.315
ACMA	DC22-2067	1522.51	1668.77	146.26	0.131
Divide	DC22-2072	461.52	487.57	26.05	0.720
ACMA	DC22-2056	8.01	43.73	35.73	0.512
Lewis	DC22-2130	2960.79	3017.22	56.43	0.324
Lewis	DC22-2110	518.31	539.80	21.49	0.846
Divide	DC22-2081	590.22	659.78	69.55	0.255
Lewis	DC22-2183	205.15	284.78	79.63	0.221
Lewis	DC22-2177	552.85	649.02	96.16	0.175
Lewis	DC22-2109	309.12	396.00	86.88	0.194

monitoring of Crooked Creek under its established aquatic resource monitor plan. Major state and federal permitting for the project is almost complete. The company has been maintaining its permits, defending them from challenges, and building up its environmental compliance system.

In 2022, Donlin Gold applied for a new air quality permit from the Alaska Department of Environmental Conservation (ADEC) and a draft permit was issued for public comment in December 2022. Donlin Gold also submitted its application to ADEC for the regularly scheduled re-issuance of its Alaska Pollutant Discharge Elimination System permit. In December 2022, ADEC sent a letter indicating that the application was complete, and that the permit would remain in effect until ADEC completes the reissuances process. On November 1, 2022, the ADNR finalized the re-location plan for public easements in the mine site and transportation facility areas.

Donlin Gold's Clean Water Act (CWA) Section 401 certification of the CWA Section 404 permit was appealed in Alaska Superior Court by a non-governmental organization representing Orutsararmiut Native Council in June 2021. ADEC had previously upheld a certification of reasonable assurance that the proposed Donlin Gold Mine would comply with the state's water quality standards.

Twelve water rights permits were finalized and issued by ADNR's Division of Mining Land and Water in 2021. Earthjustice, on behalf of ONC and five villages, filed an appeal of the final water rights permits in Alaska Superior Court on May 25, 2022. Earthjustice filed its initial brief on November 21, 2022. ADNR's and Donlin Gold's response briefs were due by January 30, 2023. A decision is expected in 2023 or the first half of 2024.

In April 2020, ADNR's Division of Oil and Gas agreed to reconsider its decision on the State Right of Way (ROW) for a proposed 316-mile

long buried natural gas pipeline originating at Cook Inlet. On July 19, 2021, the ADNR Commissioner completed the reconsideration and upheld the State ROW. In September 2021, two appeals of the State ROW were filed in Alaska Superior Court, one by Earthjustice representing Orutsararmiut Native Council, Cook Inletkeeper, and three villages, and one by an outdoor recreational business owner in the pipeline area.

On April 5, 2022, Earthjustice filed its opening brief. ADNR, Donlin Gold, and Calista filed response briefs on June 15-16, 2022. Earthjustice filed responses on July 18, 2022, and then requested oral arguments. The second appellant filed his initial brief on June 8, 2022. ADNR's and Donlin Gold's response briefs were submitted on August 22, 2022, and the second appellant filed their response brief on November 9, 2022. The request for oral arguments was granted by the Court. The oral arguments and decisions are expected in 2023.

In September 2022, 13 Tribes sent a letter to the U. S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA) requesting that the USACE consider requiring a supplemental EIS on the Donlin Gold project and revoking the CWA Section 404 permit due to what the Tribes considered "new information" since the final EIS was issued in 2018. Also in September 2022, the same Tribes submitted a separate letter to EPA requesting that they initiate a CWA Section 404(c) veto process for the Donlin Gold project. Section 404(c) has recently been applied to the Pebble project but is extremely rarely used by EPA.

Donlin Gold, together with its Native corporation partners Calista Corporation and The Kuskokwim Corporation, carried out a wide range of community engagement and support initiatives during the year. Supported Community programs included "In It For The Long Haul" backhaul project, Clean-Up Green-Up program, and the Summer Safety program.

## Pebble

The Pebble porphyry copper–gold–molybdenum deposit is one of the world’s largest undeveloped mineral resources. The project is being advanced by the Pebble Limited Partnership, a wholly owned subsidiary of Northern Dynasty Minerals, Ltd. From 2001, when Northern Dynasty’s involvement at the Pebble project began, to December 31, 2021, a total of \$893 million has been invested in the project.

The Pebble deposit comprises two zones, the surface-minable Pebble West, and the larger and higher-grade Pebble East, which would require underground block-cave mining. Combined, the deposit has a total mineral resource (all categories) of 82.0 billion pounds of copper, 106.5 million ounces of gold, 5.6 billion pounds of molybdenum, 515 million ounces of silver, and 4,630 tons of rhenium (app. D). Elevated levels of palladium, vanadium, titanium, and tellurium were noted in raw analytical data and in metallurgical studies. These metals represent other economic opportunities of the Pebble deposit.

The 2021 Pebble project preliminary economic assessment estimated a total initial capital cost for the design, construction, installation, and commissioning of the proposed project of \$6.05 billion, including all direct, indirect, and other costs. The proposed project would provide 20 years of open-pit mining with a processing rate of 180,000 tons per day, an internal rate of return of 15.7 percent, and a net present value of \$2.3 billion at a 7 percent discount rate. Average annual metal production is projected to be 320 million pounds of copper, 368,000 ounces of gold, 15 million pounds of molybdenum, 1.8 million ounces of silver, and 26,450 pounds of rhenium. Life of mine metal production was calculated as 6.4 billion pounds of copper, 7.4 million ounces of gold, 300 million pounds of molybdenum, 37 million ounces of silver, and 0.5 million pounds of rhenium. The average annual net smelter return

would be \$1.6 billion, with a life of mine net smelter return of \$32 billion.

The Pebble project could potentially provide more than \$8 billion to southwest Alaska through the Pebble Performance Dividend and the Lake and Peninsula Borough severance tax over the life of the potential mining scenarios. This monetary benefit is in addition to the benefits that could flow from the existing and possible future agreements with Alaska Native Village Corporations.

A six-week field program in 2022 focused on environmental management and sustainability. The main activities of the work program included site care, maintenance, and inspection; and permanent closure of select drill holes where the collection of baseline hydrology data for the site had been completed. Work also included the cleanup of a logistical storage area on the property that had been damaged by a wildfire - part of the broader wildfire activity that occurred in Alaska during the summer of 2022. All field crew members and Pebble Limited Partnership’s onsite field supervisor were residents of the nearby communities of Kokhanok, Iliamna, and Newhalen.

Pebble Limited Partnership facilitated the federal EIS permitting process and subsequent appeal from 2017 to through 2022. They also engaged and consulted with project stakeholders to share information and gather feedback on the Pebble project, its potential effects, and proposed mitigation.

On November 25, 2020, the USACE denied Pebble Limited Partnership’s CWA Section 404 permit, stating that the Compensatory Mitigation Plan (CMP) was not adequate to compensate for the expected impacts of the project, and that the project was not in the public interest. Pebble Limited Partnership submitted its request for an appeal of the Record of Decision to USACE on January 19, 2021. The appeal process continued into 2022.

On December 1, 2022, the EPA Region

10 recommended prohibiting and restricting the use of certain waters in the Bristol Bay watershed as a disposal site for the discharge of dredged or fill material associated with mining at the Pebble deposit. EPA Region 10 exercised its authority under Section 404(c) of the CWA and its implementing regulations at 40 Code of Federal Regulations (CFR) Part 231 because of the unacceptable adverse effects on anadromous fishery areas in the Bristol Bay watershed likely to result from discharges of dredged or fill material associated with such mining. The EPA concluded that mine development would have “unacceptable adverse effects” on salmon populations in the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek watersheds, that drain into the Nushagak and Kvichak Rivers.

Specifically, the EPA determined that discharges of dredged or fill material would result in the permanent loss of approximately 8.5 miles of anadromous fish streams, 91 miles of additional tributaries, and 2,108 acres of wetlands. Discharges could also adversely affect 29 miles of additional anadromous waters downstream of the mine site due to changes in average monthly streamflow.

### Groundhog

The Groundhog prospect, explored by Lion Copper and Gold Corp. and Chuchuna Minerals Company, is a copper–gold porphyry exploration project lying 190 miles southwest of Anchorage and 14 miles north of the Pebble deposit. No fieldwork was conducted in 2022. On December 13, 2022, the Groundhog property was transferred from Lion Copper and Gold Corp. to Blue Copper Resources Corp.

### Terra

WestMountain Gold Inc. did not work at its structurally controlled, high-grade Terra gold vein system in the western Alaska Range during 2022. The project hosts an estimated 420,000 ounces of gold at an average grade of 0.446 ounces of gold per ton (app. D). All permits and reclamation plans for continued exploration were renewed in 2021. Samples were collected outside

of the current resource areas to test possible new mineralized zones.

## Alaska Range

### Estelle

Nova Minerals Ltd. continued its extensive exploration of the Estelle gold project in the western Alaska Range, approximately 110 miles northwest of Anchorage. The Estelle project covers a 125 square mile property with a 22-mile long corridor. There are 21 identified gold prospects, and the project’s Korbel Main-area deposit is a near-surface, reduced-intrusion-related gold system with gold-bismuth-tellurium-bearing quartz–arsenopyrite-chalcopyrite-pyrrhotite veins and associated quartz-sericite-pyrite alteration.

The RPM North deposit hosts 25.35 million tons of inferred resources averaging 0.058 ounces of gold per ton, totaling 1.5 million ounces of gold. The JORC-compliant resource at the Korbel Main deposit is 8.1 million ounces, including 315.26 million tons of indicated resource averaging 0.009 ounces of gold per ton (3 million ounces of gold) and 642.65 million tons of inferred resource averaging 0.009 ounces of gold per ton (5.1 million ounces of gold). The Estelle project has a total mineral resource of 9.6 million ounces of gold (app. D).

Nova Minerals continued exploration at the Estelle project in 2021. Core drilling was conducted with up to five drill rigs, at the Korbel and RPM prospects. RC drilling was conducted at blocks C and D, Isabella and Connex across the flat ground of the Korbel Valley. Drilling continued throughout the year with higher-grade feeder zones discovered at the Korbel Main deposit and a bonanza gold grade reported at the RPM North deposit.

Nova Minerals also started exploring some of the other 19 identified prospects within the Estelle trend. An exploration mapping and sampling campaign at the Train and Shoeshine prospects discovered another large gold system exposed at surface with a 0.6-mile long and

0.3-mile wide strike at the Train prospect, and 0.6-mile long strike length at the Shoeshine prospect. High-grade reconnaissance rock samples yielded analytical results up to 0.888 ounces of gold per ton.

Nova Minerals released a scoping study for the Korbelt Main deposit in February. The study confirms the viability of a large stand-alone, bulk-tonnage open-pit mining operation at the Korbelt Main deposit with a 15-year evaluation period. Estimated cash costs averaged \$990 per ounce of gold and the all-in-sustaining costs averaged \$1,120 per ounce of gold over the evaluation period. A conventional truck and shovel mining and mill operation would produce 1,956,000 ounces of gold over the evaluation period, with an anticipated 88 percent gold recovery.

The scoping study estimated that preproduction capital costs for a 6.6 million ton per year plant and infrastructure would be approximately \$424 million, inclusive of \$57 million for mining fleet equipment and contingencies. There are attractive financial outcomes with a pre-tax net present value of \$381 million, a pre-tax internal rate of return of 20.4 percent and total period revenue of \$3.4 billion, based on a \$1,750 per ounce of gold price. The calculated payback period is three years with an average annual production of 186,000 ounces of gold during that period.

Nova Minerals drilled five areas of the Estelle property with multiple rigs in their 2022 diamond drilling program. Approximately 29,500 feet of close spaced infill and step-out drilling in 24 holes was completed at the RPM North deposit to prove up and expand existing inferred resources to indicated and measured levels. The RPM South prospect was drilled for the first time, with 8 holes totaling approximately 10,000 feet. Selected geochemical results from the 2022 drilling program are listed in table 14.

Infill drilling at the Korbelt deposit consisted of 30 holes totaling approximately 33,000 feet. The drilling targeted the saddle area within

the proposed conceptual Korbelt Main pit zone to convert additional inferred into the higher indicated category. No results were announced.

A maiden drilling program at the Cathedral prospect totaled approximately 16,000 feet in 12 holes. Drilling highlights are listed in table 13. Mineralization remains open from surface in all directions, with over 1,600 feet of strike length and up to 1,000 feet in width.

Nova Minerals also completed a ground water monitoring drilling program. Twelve holes totaling approximately 3,300 feet were drilled as part of an environmental studies program.

The 2022 exploration mapping and soil and rock sampling campaign confirmed the discovery of a new broad zone of high-grade gold mineralization at the recently named Trumpet prospect, located 1 mile northwest of the Train prospect. Rock samples were collected of sheeted quartz-tourmaline veins with massive arsenopyrite and lesser amounts of chalcopyrite in granodiorite. Numerous highly anomalous gold values were returned from rock and soil samples at the Train and Trumpet prospects. Highlight results include 2.339 ounces of gold per ton from a subcrop rock sample at the Train prospect and 0.957 ounces of gold per ton from a rock sample at the base of an outcrop at the Trumpet prospect.

### **Monte Cristo**

Ragusa Minerals Ltd. controls the 125 square mile, intrusion-related gold Monte Cristo property near Estelle and Whistler North. The Monte Cristo property consists of 500 State of Alaska mining claims and covers a 35-mile long under-explored area. The project area contains four historical prospects – Monte Cristo, St. Eugen, Old Man Breccia and Old Man Diorite.

Ragusa's 2022 exploration program included sampling of the Old Man Diorite and Old Man Breccia prospects at the north end of the Monte Cristo property and the Emerald prospect at the southwest end of the land package. Results from the field sampling conducted during 2022

**Table 14.** Top 23 intercepts from the 2022 Nova Minerals drilling program

Zone	Hole Number	From (ft)	Interval (ft)	Grade Au (opt)
RPM North	RPM-008	144.36	459.34	0.190
RPM North	RPM-010	0.00	551.21	0.067
RPM North	RPM-015	0.00	528.24	0.236
RPM North	Main Zone RPM-022	367.47	219.83	0.303
RPM North	Main Zone RPM-025	141.08	203.42	0.175
RPM North	Middle Zone RPM-025	944.93	101.71	0.020
RPM North	Lower Zone RPM-025	1443.64	249.36	0.035
RPM North	Upper RPM-030	311.70	249.36	0.052
RPM North	Lower RPM-030	666.04	101.71	0.047
RPM North	RPM-033	134.52	351.07	0.216
RPM North	RPM-036	364.19	242.79	0.023
RPM North	Upper RPM-037	134.52	321.54	0.050
RPM North	Lower RPM-037	1066.33	337.94	0.029
RPM South	RPM-023	26.25	380.60	0.026
RPM South	RPM-013	9.84	331.38	0.020
RPM South	RPM-019	16.41	849.78	0.017
RPM South	RPM-026	22.97	1013.83	0.015
RPM South	RPM-028	26.25	429.81	0.017
RPM South	RPM-029	16.41	49.22	0.035
RPM South	RPM-032	88.59	410.13	0.017
RPM South	RPM-034	29.53	469.18	0.015
Cathedral	CTDD-001	341.22	1161.47	0.009
Cathedral	CTDD-003B	551.21	882.59	0.012

returned strongly anomalous gold grades. The anomalous results were relatively localized in each prospect, providing strong focal points for future exploration.

The 2022 investigation of the Old Man prospect area included the collection of 54 samples from talus and rocks accumulated at the base of a very steep rock face, with grades as high as 0.499 ounces of gold per ton. Grades up to 0.020 ounces of gold per ton were found in 41 outcrop or subcrop samples. A total of 130 soil samples were collected from slopes and beneath inaccessible areas on ridge lines, with a peak grade of 0.093 ounces of gold per ton.

Sampling at the Emerald prospect targeted intrusion-related quartz sulfide veins, in a

strongly oxidized host. A total of 14 rock float samples were collected, with grades as high as 0.006 ounces of gold per ton. Grades up to 0.091 ounces of gold per ton were present in 31 outcrop or subcrop samples. A total of 88 soil samples were collected, with peak grades of 0.068 ounces of gold per ton.

### **Whistler**

The Whistler project is a gold-rich porphyry copper project consisting of 304 State of Alaska mining claims across roughly 42,000 acres in the Alaska Range 105 miles northwest of Anchorage and 81 miles west of Willow. Current year-round access to the property is via aircraft flying into the Whiskey Bravo airstrip shared with Nova Minerals Ltd.'s Estelle project. More than \$36

million has been spent exploring the Whistler property for gold-copper porphyry and intrusion-related gold deposits since initial exploration by Cominco Alaska Inc. in 1986. A total of 230,469 feet of diamond drilling in 257 holes were drilled on the Whistler property from 1986 to 2011, with 69,331 feet in 52 holes drilled in the Whistler Deposit area, 67,188 feet in 94 holes drilled in the Raintree area, 47,277 feet in 36 holes drilled in the Island Mountain resource area, and 46,673 feet in 75 holes drilled in areas outside the three resource areas. No significant exploration work has been completed on the project after 2016, including no significant fieldwork in 2022.

GoldMining Inc. announced an updated mineral resource estimate for the Whistler, Raintree West, and Island Mountain deposits in June 2021 (app. D). The Whistler, Raintree West, and Island Mountain deposits host 130.3 million tons of indicated resource averaging 0.015 ounces of gold per ton (1.94 million ounces), 0.064 ounces of silver per ton (8.3 million ounces), and 0.16 percent copper (422 million pounds). The deposits also have an additional inferred resource of 349 million tons averaging 0.013 ounces of gold per ton (4.67 million ounces), 0.046 ounces of silver per ton (16.1 million ounces), and 0.10 percent copper (711.4 million pounds). The Whistler deposit is estimated to contain an indicated resource of 1.75 million ounces of gold, 399 million pounds of copper, and 6.76 million ounces of silver, with an inferred resource of 1.71 million ounces of gold, 455 million pounds of copper, and 7.31 million ounces of silver. The Raintree West deposit has an open-pit indicated resource of 0.12 million ounces of gold, 15 million pounds of copper, and 1.22 million ounces of silver, with an inferred open-pit resource of 0.29 million ounces of gold, 18 million pounds of copper, and 1.73 million ounces of silver. The Raintree West deposit also has an underground indicated resource of 0.07 million ounces of gold, 8 million pounds of copper, and 0.36 million ounces of silver, with an inferred underground resource of

1.03 million ounces of gold, 107 million pounds of copper, and 3.21 million ounces of silver. The Island Mountain deposit has an inferred open-pit resource of 1.70 million ounces of gold, 131 million pounds of copper, and 3.81 million ounces of silver.

In 2022, GoldMining Inc. announced the creation of a new subsidiary, U.S. GoldMining Inc., to advance the company's Whistler copper-gold-silver project. No significant fieldwork was conducted on the property in 2022.

### Nyac

Calista Corporation performed exploration work on their lands in the Nyac mining district to explore for the lode source of the Nyac placer resources. Exploration work for 2022 consisted of prospecting, geological mapping, and rock and soil sampling. New mineralization occurrences were identified and known occurrences were extended. Shareholders from the local community were rehired and hired anew, and completed a formal prospector training program. The exploration project operated safely and successfully with a crew of shareholders from the local community under Calista's COVID mitigation policy and workforce and community protection plan adapted for the field with zero COVID cases.

### Shotgun

The Shotgun project is an intrusion-related gold system in the southern Kuskokwim region. Shotgun has an inferred resource of 706,000 ounces of gold (app. D). TNR Gold Corp.'s 2022 field program at the Shotgun and Winchester prospects investigated the geochemical anomalies generated by the 1998 Novagold Resources soil surveys and the geophysical targets indicated by anomalies from the SJ Geophysics 2011 and 2012 EM surveys.

### Flat

Tectonic Metals Inc. completed an inaugural field program at the Flat gold project leased from Doyon Limited. This is the first exploration work at the property in more than 20 years.

The Flat project consists of two main target areas, Chicken Mountain and Black Creek/Golden Horn. The Chicken Mountain quartz monzonite stock hosts quartz veins containing free gold, arsenopyrite, pyrite, stibnite, cinnabar, and rare chalcopyrite. Gold mineralization as native gold, with associated arsenopyrite, pyrite, stibnite, cinnabar, and rare chalcopyrite, at the Black Creek/Golden Horn target is contained within northeast-striking, steeply-dipping, sheeted subparallel veins. Mineralization is hosted within sedimentary and volcanic rocks, especially along the eastern contact of the Black Creek stock.

Tectonic relogged 35 historical drillholes totaling 16,188 feet from the Chicken Mountain prospect. Baseline metallurgical studies comprising sample characterization, cyanide leach test, gravity recovery, and flotation recovery were conducted on 5 core sample composites. During September, Tectonic conducted an inaugural field exploration campaign, including verification of historical location data, and mapping and sampling of surface exposures. In total, 1,129 feet of channel samples, along with 19 grab samples, were collected.

### West Susitna Access Road

The Alaska Industrial Development and Export Authority (AIDEA) is working on the West Susitna Access Road project, which would extend into resource-rich areas west of Cook Inlet. Originally proposed under Alaska's Roads to Resources program, the West Susitna Access Road would run about 100 miles northwest from the Port MacKenzie area, opening the west side of Cook Inlet.

The USACE accepted AIDEA's permit application for the Section 404 of the CWA on October 14, 2022, initiating the National Environmental Policy Act compliance process for the environmental review of the proposed West Susitna Access Road.

### Luna

Mamba Minerals LLC acquired the Luna,

Quicksilver, and Kisa gold properties in 2021. No 2022 work was announced.

## Southeastern Region

### Greens Creek

Exploration at the operating silver-gold-zinc-lead Greens Creek Mine, southwest of Juneau, is by Hecla Mining Company who ensures reserves at least 10 years ahead of current mining of the volcanogenic massive sulfide deposit. See appendix D for detailed reserves and resources for the Greens Creek deposit.

Underground definition and exploration drilling during 2022 focused on seven of the nine known mineralized zones on the property. Three underground core drills worked on exploration in the East, 5250, 200 South, and Gallagher Fault Block zones.

Drilling highlights at the Southwest Bench zone include 74.3 ounces of silver per ton, 0.52 ounces of gold per ton, 5.7 percent zinc, and 2.9 percent lead over 10.5 feet, and 25.7 ounces of silver per ton, 0.15 ounces of gold per ton, 6.4 percent zinc, and 3.1 percent lead over 20.1 feet. Drilling at the 200 South zone included 18.5 ounces of silver per ton, 0.02 ounces of gold per ton, 2.6 percent zinc, and 1.1 percent lead over 44.7 feet. Drilling at the East zone intersected two significant intercepts, with 51.6 ounces of silver per ton, 0.05 ounces of gold per ton, 0.1 percent zinc, and 0.0 percent lead over 11.1 feet and 227.8 ounces of silver per ton, 2.84 ounces of gold per ton, 4.2 percent zinc, and 0.4 percent lead over 2.9 feet. Significant drill intercepts at the West zone included 37.0 ounces of silver per ton, 0.26 ounces of gold per ton, 18.3 percent zinc, and 9.5 percent lead over 47.2 feet, and 55.2 ounces of silver per ton, 0.16 ounces of gold per ton, 16.5 percent zinc, and 8.9 percent lead over 31.2 feet.

Two helicopter supported core drills focused on drilling extensions to the Upper Plate zone near the mine and the Lil' Sore target area approximately 3 miles northwest of the mine.

## Kensington

The Kensington Mine lies 43 miles northwest of Juneau and is owned and operated by Coeur Alaska Inc. Surface and underground exploration focused on increasing the mine's current gold reserves and resources. Coeur spent roughly \$11 million and conducted the biggest exploration program in Kensington Mine history in 2022. Exploration drilling increased gold reserves by roughly 56 percent year-over-year, adding approximately a year and a half to the mine life (see app. D for details).

The Kensington exploration drill program included up to four underground drill rigs and one surface drill rig. Drilling continued throughout the year. Surface drilling targeted expansion drilling at the Kensington main and the Jennifer zones, as well as scout drilling in the Valentine/Fremming and Comet areas. Underground drilling, mostly focused on expansion and infill drilling, continued throughout the year on multiple zones at the Elmira, Kensington, Kensington zone 30, Jualin, Eureka, and Johnson areas,

Infill drilling at Kensington zone 30, zone 30A, zone 30B, zone 12 and Elmira continued to trace structures to the south and down dip. Mineralized zones intercepted during drilling had consistent widths and grades with the potential to extend the mine life.

The Elmira vein system shares similar vein style and mineralization characteristics with the Kensington deposit, lying 2,500 feet east of Kensington. Recent drilling and development on the Elmira deposit continues, with initial production planned in 2023. Drilling focuses on expanding Kensington and Elmira resources to the south, and on the Johnson prospect to the east of Elmira. These successes demonstrate the continuing exploration potential to advance additional deposits within the district.

## Palmer Project

The Palmer project near Haines is being explored by partners Constantine Metal

Resources Ltd. and Dowa Metals & Mining Alaska Ltd. Palmer is an advanced-exploration-stage, zinc–copper–silver–gold–barite volcanogenic massive sulfide-sulfate deposit that occurs in the same belt of rocks that hosts the Greens Creek Mine. The RW and South Wall zones contain an indicated mineral resource of 5.16 million tons grading 5.23 percent zinc, 1.49 percent copper, and 0.90 ounces of silver per ton, and an inferred mineral resource of 5.88 million tons grading 5.20 percent zinc, 0.96 percent copper, and 0.853 ounces of silver per ton. See appendix D for mineral resource details

American Pacific Mining Corp. acquired all issued and outstanding common shares of Constantine Metal Resources Ltd. American Pacific has a 41.08 percent ownership of the Palmer project, and Dowa owns 58.92 percent of the joint venture. American Pacific is the project manager.

The \$10.4 million work program at the Palmer project in 2022 focused on preparations for initiating an extensive underground exploration program in 2023. A seven-hole exploration drilling program totaling 11,634 feet tested the offset of the South Wall deposit and the Terminus and Jasper Mountain targets. No results were announced.

An engineering review of the underground portal access road was completed. Review of the access road construction was approximately 60 percent completed. Other engineering studies included a production site evaluation with analysis of alternate production portal, mill, and tailing management.

Work continued on environmental baseline studies and permits compliance. Permitting and site preparation also continued for a 60-person all-season camp slated for occupancy in June 2023 to support the planned exploration activity.

The 2019 preliminary economic assessment was amended and replaced by a technical report in March 2022. The amended technical report does not change the accompanying

mineral resource estimates, economic analysis, conclusions, and recommendations provided in the original report for the Palmer project.

### **Big Nugget Project**

In August 2020, Constantine announced that it identified a potential source area for the historic Porcupine gold placers. No fieldwork was conducted on the Big Nugget project in 2022.

### **Bokan Mountain**

Ucore Rare Metals Inc.'s Bokan Mountain property on Prince of Wales Island, 35 miles southwest of Ketchikan, has Alaska's only defined resource of rare earth elements (REE). The deposit is hosted in an Early Jurassic igneous complex composed of peralkaline granitic rocks with silicate vein dikes enriched in both light and heavy rare earth elements. The deposit is particularly rich in the more valuable and strategically important heavy REE, with a 5.28 million ton indicated resource and a 1.16 million ton inferred resource of REEs (see app. D for resource details).

Ucore retained Aurora Geosciences (Alaska) Ltd. to conduct a field program at the Bokan Mountain project. Two geologists and three geotechnical laborers were on site from May 13 to June 10. Two 25-ton bulk samples were collected from the western portion of the main Dotson Ridge mineralized zone. A total of 31 new sites across the entire Dotson Ridge zone were channel sampled and consisted of 137 samples to fill in gaps in Aurora's geological model of the deposit and improve the confidence level of the published resource for the property. The field work was successfully completed and was designed to improve the geological confidence of the mineral deposit in preparation for a planned pre-feasibility study.

Ucore retained SGS Canada Inc. to conduct a metallurgical test work program on a composite sample from the Bokan-Dotson Ridge mineral resource in support of a prefeasibility study.

On October 17, 2022, Ucore announced that it entered into a mutual commitment with

the State of Louisiana toward the establishment of a strategic metals complex REE separation facility in Louisiana. Ucore determined that the Louisiana site offered a better chance of achieving a time efficient and lower capital cost facility than constructing a new site in Alaska. Ucore and its advisors remained in discussions with the State of Alaska. Current plans are to develop a commercial processing facility in Ketchikan after the Louisiana facility is established.

### **Herbert Gold**

Grande Portage Resources Ltd. staged an exploration drill program at its Herbert Gold project near Juneau, a vein-hosted orogenic system that is part of the Juneau Gold Belt. Mineralization in the Herbert gold vein system appears to be constrained to a competent quartz diorite block sandwiched between two major northwest-striking, moderately northeast-dipping faults which are greater than a half mile apart. The project hosts 1.52 million ounces of gold at an average grade of 0.29 ounces of gold per ton (indicated plus inferred resources; app. D).

Grande Portage drilled 11,915 feet of core in five holes. The drill program targeted step-out and in-fill holes, testing the prospect's primary veins, but also penetrating the eastern extension of the Sleeping Giant and North veins, as well as numerous subsidiary veins and structures. Geochemical results included 0.184 ounces of gold per ton in a 2.5-foot intercept of the Sleeping Giant vein in hole 22AB-3, 0.177 ounces of gold per ton in a 2.5-foot intercept of the Sleeping Giant vein in hole 22AB-4, and 0.094 ounces of gold per ton in a 4-foot intercept of the Goat vein in hole 22AB-4.

Ten mining claims were staked to cover the northeastern extension of the property. The prospective ground has potential to expand the gold resource.

### **Helm Bay**

Helm Bay is a historical gold mining area located on the Cleveland Peninsula about 25

miles north of Ketchikan. Surface exploration activities at Agnico Eagle (USA) Ltd.'s Helm Bay project in 2022 were limited to surface geochemical sampling, airborne geophysics, and drill planning. Field activities for permitting included botany and archeological surveys.

### **Niblack**

Niblack is an advanced-exploration-stage copper–gold–zinc–silver project on Prince of Wales Island, approximately 27 miles southwest of Ketchikan. The property hosts six known zones of VMS mineralization, including the Lookout and Trio deposits, which host a combined total of almost 10 million tons of mineralization grading 0.8 percent copper, 1.3 percent zinc, 0.04 ounces of gold per ton, and 0.59 ounces of silver per ton (app. D). The property is owned and explored by Blackwolf Copper and Gold Ltd.

Blackwolf planned to release an updated mineral resource estimation for the Niblack deposit in the first quarter of 2023. In June 2022, Blackwolf received its permit for surface exploration work at the Niblack project from the U.S. Forest Service. The authorized surface exploration, subject to various terms and conditions and bonding, includes detailed geological mapping; ground based Induced Polarization geophysics, soil sampling, and a maximum of 15 sites for diamond core drilling; soil sampling for geochemical analysis; and diamond core drilling at a maximum of 15 sites.

### **Hyder**

Blackwolf Copper and Gold Ltd. continued work on their Hyder properties that include numerous historical, high-grade gold-silver prospects and mines near Hyder and on the Alaska side of British Columbia's famed Golden Triangle. Blackwolf staked the Texas Creek, Cantoo, and Casey claim groups in 2021, totaling almost 11,000 acres and 474 federal mining claims. In May, Blackwolf staked 60 federal lode and four State of Alaska claims comprising the Mineral Hill property.

Exploration during the 2022 field season at

five Hyder area properties included collecting 330 rock grab and chip samples, geologic mapping, aerial photography, lidar surveys, and a high-resolution World-View 3 remote sensing survey. Grab samples of structurally controlled, quartz-sulfide vein mineralization from the Solo prospect included two samples with geochemical results of 0.601 ounces of gold per ton and 11.258 ounces of silver per ton, and 0.175 ounces of gold per ton and 111.883 ounces of silver per ton. Fifteen samples were collected from a series of northeast-trending quartz-sulfide veins traced over 725 feet along strike at the Doghole prospect, with sample results up to 0.484 ounces of gold per ton and 17.004 ounces of silver per ton.

Experienced climbing technicians accessed the upper, gold-rich vein exposed in cliffs on the eastern flank of Cantoo Mountain and retrieved a composite rock chip sample assaying 1.097 ounces of gold per ton. The mineralization was associated with intense silicification, stockwork style quartz-pyrite veining, and up to 25 percent disseminated pyrite mineralization in a series of stacked, shallow southwesterly-dipping veins and stockwork zones. Grab samples of intensely altered rock from the peripheral portion of the vein returned values up to 0.022 ounces of gold per ton, suggesting bleed-out of mineralization into the altered wallrock. Additional zones of veining and alteration were noted on the cliff below this upper vein but were not sampled due to safety concerns.

### **Apex El Nido**

The Apex high-grade gold prospect is located on the northern portion of Chichagof Island, near the community of Pelican, approximately 75 miles west-southwest of Juneau. The property consists of 39 unpatented federal mining claims on National Forest lands totaling approximately 780 acres. The Apex Mine, with four levels of underground workings totaling 3,900 feet, produced approximately 18,000 ounces of gold and 2,400 ounces of silver from 1923 to 1936 at an average grade of 1.4 ounces of gold per ton.

Millrock Resources Inc. controlled the property. No work was completed in 2022 after Coeur Explorations Inc. terminated an option agreement in late 2021.

## Alaska Peninsula Region

### Unga Project

Heliostar Metals Ltd.'s Unga epithermal gold–silver project includes the past-producing Apollo–Sitka Mine and the Shumagin, Centennial, and Aquila prospects on Unga and Popof islands. The Apollo Mine was Alaska's first underground gold mine, producing an estimated 130,000 ounces prior to its closure in 1922. The SH-1 vein has an inferred resource of 384,300 ounces of gold at an average grade of 0.40 ounces of gold per ton, and 986,300 ounces of silver at a grade of 1.03 ounces of silver per ton (app. D).

Heliostar carried out a drill program on the Unga project in 2021. Work in 2022 consisted of community relations work and site visits. Historical data compilation and mine engineering work were conducted for the potential re-opening of past underground workings for exploration access.

## DEVELOPMENT AND PRODUCTION

Mining development expenditures in Alaska increased 15 percent to \$391.0 million in 2022 (table 15). Projects and capital expenditures delayed in 2020 due to the pandemic continued to be advanced with strong mitigation measures. Alaska's seven large operating mines reported development expenditures (fig. 6). Currently, only capital expenditures at Alaska's large operating mines are contributing to this category, which is sensitive to the timing of high-cost individual projects. Placer mining and quarry development expenditures are not tabulated in this report. Development expenditures for placer and sand and gravel operations are believed to be minor compared to the large mines. Expenditures at permitting-stage projects are tabulated in the

exploration section of this report.

Development and production estimates are compiled from a variety of online sources: annual reports, company financial reports, and news releases by companies. They are supplemented by questionnaires returned to DGGs by mining companies, as well as news releases and personal communications such as phone calls and emails.

Over the last 15 years, most development work has been conducted at mine sites, with development activities being integral to the mining operations. Additionally, there have been few purely development-stage projects. The development sector of the mining process refers to building infrastructure or conducting activities that facilitate production of mineral products. Development expenditures reflect actual expenditures at mines as well as sustaining capital. Sustaining capital includes equipment replacement and rebuilding, facility upgrades, and other expenditures that must be amortized or depreciated in accordance with tax laws; and thus, are frequently reported as distinct line items in securities filings. Development activities, whether to build a new mine or make improvements to an existing mine, are often precursors to increased annual production or extended mine life, while production expenditures include those costs directly related to the production of metals.

Average metal prices used in this report are based on the average daily London Metal Exchange (LME) price (table 16). Some respondents reported actual unit values received for production. In cases where actual values were available, they were used in place of the average values. This report uses revenue as reported by producers to quantify production values. If unavailable or confidential, the theoretical first market value (estimated gross value of a pure mineral product at first wholesale) is used instead to approximate the value of production. Therefore, the theoretical first market value does not represent actual sales or gross income of producers; does not consider shipping, smelting, refining, and other costs incurred by the

**Table 15.** Reported mineral development expenditures in Alaska by commodity, 1982–2022

Year	Base Metals	Polymetallics <sup>a</sup>	Precious Metals	Gemstones <sup>b</sup>	Industrial Minerals	Coal and Peat	Total
1982	\$ 10,270,000		\$ 19,320,000		\$ 4,251,000	\$ 7,750,000	\$ 41,591,000
1983	19,500,000		7,112,500		1,000,000	250,000	27,862,500
1984	10,710,500		15,058,555		579,000	27,000,000	53,348,055
1985	13,000,000		16,890,755		1,830,000	2,400,000	34,120,755
1986 <sup>a</sup>	3,260,800	\$ 8,000,000	12,417,172		124,000	530,000	24,331,972
1987	38,080,000	48,000,000	13,640,848		188,000	342,000	100,250,848
1988	165,500,000	69,000,000	40,445,400		-	-	274,945,400
1989	118,200,000	411,000	6,465,350		7,000,000	2,196,000	134,272,350
1990	-	4,101,000	7,136,500		30,000	3,079,000	14,346,500
1991	-	8,000,000	14,994,350		262,000	2,318,000	25,574,350
1992	80,000	4,300,000	23,151,300		404,000	1,655,000	29,590,300
1993	-	10,731,136	15,103,000		433,500	1,400,000	27,667,636
1994	10,000,000	5,000,000	27,392,850		5,000	2,545,000	44,942,850
1995	11,200,000	9,590,000	127,165,750		426,000	200,000	148,581,750
1996	60,000,000	60,100,000	273,042,000		495,000	400,000	394,037,000
1997	133,880,000	7,300,000	26,299,000		500,000	410,000	168,389,000
1998	28,000,000	5,600,000	15,602,000		5,355,000	850,000	55,407,000
1999	12,500,000	2,500,000	15,864,000		400,000	2,575,000	33,839,000
2000	100,000,000	16,400,000	24,699,000		611,000	-	141,710,000
2001	43,800,000	3,300,000	32,719,000		300,000	1,040,000	81,159,000
2002	-	5,700,000	26,655,000		250,000	1,450,000	34,055,000
2003	-	-	38,839,332		315,000	-	39,154,332
2004	17,700,000	6,215,000	177,440,081		4,991,434	2,760,000	209,106,515
2005	28,000,000	16,700,000	301,011,469		856,500	1,350,000	347,917,969
2006	31,200,000	26,183,280	420,759,203		1,566,000	15,985,000	495,693,483
2007	41,374,880	30,766,902	239,931,040		1,320,500	5,385,000	318,778,322
2008	45,000,000	24,000,000	319,702,594		205,113	7,260,000	396,167,707
2009 <sup>b</sup>	29,000,000	17,500,000	277,020,142	\$ 225,250	270,000	6,800,000	330,815,392
2010	42,000,000	16,300,000	225,793,300	200,000	-	9,000,000	293,293,300
2011	48,590,865	41,657,000	170,931,851	250,000	902,480	9,560,000	271,892,196
2012	35,234,500	62,184,000	235,642,406	-	5,290,870	4,021,544	342,373,320
2013	W	57,119,121	258,130,353	295,000	1,831,369	W	358,775,844
2014	W	W	199,909,824	700,000	756,495	-	281,735,787
2015 <sup>c</sup>	W	W	188,226,940	-	-	-	309,938,884
2016	W	47,046,279	133,243,900	-	-	W	217,376,728
2017	W	35,254,986	209,082,444	-	-	W	299,502,316
2018	W	46,863,810	156,263,106	-	-	W	334,112,057
2019	W	35,830,809	184,097,276	-	-	W	347,822,085
2020	W	28,797,676	192,624,758	-	-	W	267,765,434
2021	W	27,580,819	173,969,455	-	-	W	339,089,131
2022	W	39,255,959	198,743,635	-	-	W	391,000,000
<b>Total</b>	<b>\$ 1,096,081,545</b>	<b>\$ 827,288,777</b>	<b>\$ 5,062,537,439</b>	<b>\$ 1,670,250</b>	<b>\$ 42,749,261</b>	<b>\$ 120,511,544</b>	<b>\$ 8,082,333,068</b>

<sup>a</sup>Polymetallics category added in 1986.<sup>b</sup>Gemstone development category added in 2009.<sup>c</sup>Significant development expenditures were not reported for precious metals in 2015.

- = Not reported

W = Figures withheld for confidentiality purposes. Expenditures are incorporated into the State total.

## Development & Production

### I. Northern Region

- 1 Red Dog Mine—Teck Alaska Inc.

### II. Western Region

2. Nixon Fork—Mystery Creek Resources Inc.\*

### III. Eastern Interior Region

3. Fort Knox Mine—Fairbanks Gold Mining Inc. (Kinross Fort Knox)
4. Gil Mine—Fairbanks Gold Mining Inc. (Kinross Fort Knox)
5. Pogo Mine—Northern Star Resources Ltd.
6. Manh Choh Project—Kinross Gold Corp. and Contango ORE Inc.
7. Usibelli Coal Mine—Usibelli Coal Mine Inc.

### IV. South-central Region

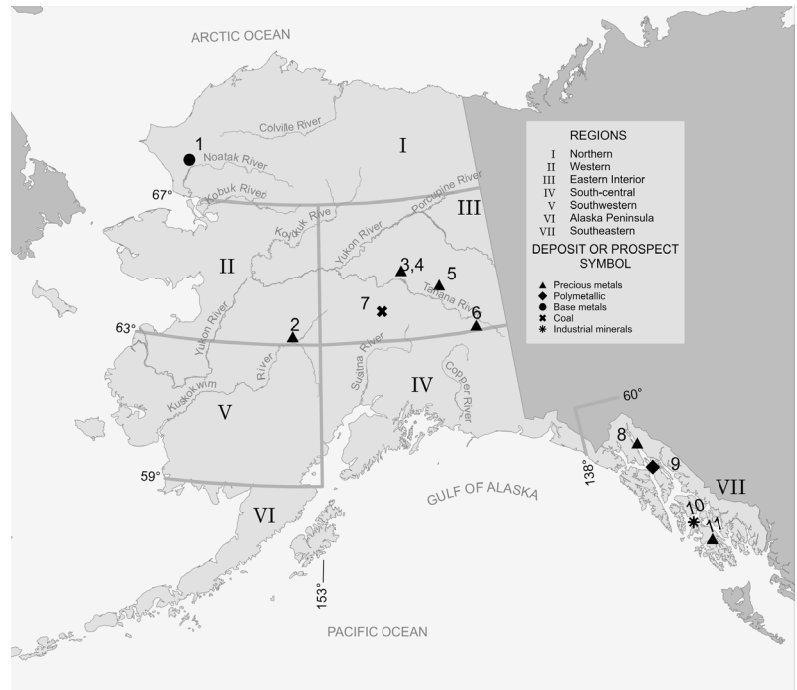
### V. Southwestern Region

### VI. Alaska Peninsula Region

### VII. Southeastern Region

8. Kensington Mine—Coeur Alaska Inc.
9. Greens Creek Mine—Hecla Greens Creek Mining Company
10. Calder Mine—Columbia River Carbonates
11. Dawson Mine—Sundance Mining Group LLC

\* Development activity only



**Figure 6.** Selected development projects and mines in Alaska, 2022.

producer; and may significantly overestimate the actual value of the material.

Alaska's mine production in 2022 provided \$3.59 billion in estimated revenue to Alaska's mineral producers. Alaska's metal mines benefited from rising 2022 gold and zinc prices. Coal production held steady. From 2021 to 2022, the total revenue realized by Alaska producers increased by 26 percent (\$3.6 billion; tables 1 and 17).

According to the USGS, the estimated total value of nonfuel mineral production in the United States was \$98.2 billion in 2022, an increase of 4 percent from the revised total of \$94.6 billion in 2021. The estimated value of metal production decreased by 6 percent to \$34.7 billion from a revised total of \$36.9 billion in 2021. The total value of industrial minerals production was \$63.5 billion, a 10 percent increase from that in 2021.

The USGS estimated the value of nonfuel mineral production in Alaska for 2022 was \$4.51 billion, ranking 6th among the 50 States and

accounting for 4.59 percent of the United States' total mineral production in 2022. The estimated revenue to Alaska's mineral industry for nonfuel mineral production for 2022 was \$3.78 billion. This estimated revenue value accounts for actual sale prices and includes smelting, refining, and transportation costs.

Zinc remains the State of Alaska's leading mineral product, having a reported production value of \$1.92 billion in 2022. Zinc accounted for 52 percent of Alaska's metal production value and gold accounted for 33 percent (fig. 7). The annual value of zinc production has exceeded that of gold since 2014 (app. B). Production of lead was significantly lower in 2022, and silver production dropped by almost one million ounces from the 2021 production volume (table 17).

United States zinc mine production increased by 9 percent in 2022 compared with that in 2021, according to USGS data. Alaska was the leading zinc-producing state in 2022, producing three times as much zinc as the four

**Table 16.** Average metal prices, 1997–2022

Year	Gold \$/oz	Silver \$/oz	Copper \$/lb	Lead \$/lb	Zinc \$/lb
1997	330.76	4.91	1.03	0.28	0.59
1998	293.88	5.53	0.75	0.24	0.46
1999	278.70	5.20	0.71	0.23	0.49
2000	279.10	4.96	0.82	0.21	0.51
2001	271.04	4.37	0.71	0.22	0.40
2002	310.06	4.61	0.41	0.21	0.35
2003	363.38	4.88	0.81	0.23	0.38
2004	409.72	6.67	1.29	0.40	0.47
2005	444.74	7.32	1.61	0.43	0.63
2006	603.46	11.55	3.02	0.58	1.47
2007	695.39	13.38	3.24	1.17	1.47
2008	871.96	14.99	3.12	0.94	0.84
2009 <sup>a</sup>	972.35	14.67	2.35	0.78	0.75
2010 <sup>a</sup>	1,224.53	20.19	3.42	0.97	0.98
2011 <sup>a</sup>	1,571.52	35.12	3.99	1.09	0.99
2012 <sup>a</sup>	1,668.98	31.15	3.61	0.93	0.88
2013 <sup>ab</sup>	1,411.23	23.79	3.32	0.97	0.87
2014 <sup>ab</sup>	1,266.40	19.78	3.11	0.95	0.98
2015 <sup>ab</sup>	1,160.06	15.68	2.50	0.81	0.88
2016 <sup>ab</sup>	1,250.74	17.14	2.21	0.85	0.95
2017 <sup>ab</sup>	1,257.12	17.04	2.80	1.05	1.31
2018 <sup>ab</sup>	1,268.49	15.71	2.96	1.02	1.33
2019 <sup>ab</sup>	1,392.60	16.21	2.72	0.91	1.16
2020 <sup>ab</sup>	1,769.64	20.55	2.70	0.82	1.01
2021 <sup>ab</sup>	1,797.24	25.11	4.23	1.00	1.36
2022 <sup>ab</sup>	1,801.87	21.75	4.00	0.97	1.58

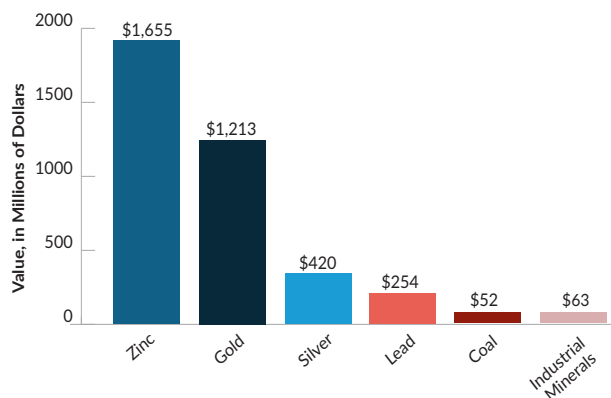
The figures in this table will change as data are reviewed and updated.

<sup>a</sup>2009–2022 gold and silver prices from Kitco cumulative average London PM fix; 2009–2012 copper, lead, and zinc from British Columbia Ministry of Energy and Mines.

<sup>b</sup>2013–2022 copper, lead, and zinc prices from U.S. Geological Survey Mineral Commodity Summaries, based on London Metal Exchange (LME), and LME average daily settlement.

other zinc-producing states combined. Zinc production at the Red Dog Mine, the largest zinc mine in the United States, increased notably compared with that in 2021, owing to higher mill throughput and zinc ore grades.

Gold production from lode mines in Alaska's Eastern Interior and Southeast regions totaled 649,517 ounces in 2022, of which 74

**Figure 7.**

Estimated 2022 mineral production value in Alaska by commodity.

percent was produced from the Fort Knox and Pogo gold mines in the Eastern Interior region (fig. 8). Kensington gold mine and Greens Creek polymetallic mine in Southeast Alaska, the third and fourth largest gold producers, along with the Dawson Mine, accounted for the remainder of lode gold production. Placer gold production in 2022 is estimated at 40,712 ounces (table 18). Employment related to gold production in 2022 is 1,810 full-time-equivalent jobs; almost 47 percent of mining jobs in all sectors (table 2).

According to the USGS, Alaska was the leading silver-producing state in 2022. In 2022, mines in the United States produced approximately 1,100 tons of silver with an estimated value of \$720 million. Alaska was the second largest producer of gold, after Nevada, according to the USGS.

According to data from the USGS, Alaska companies produced 596,000 tons of crushed stone in 2022 valued at \$6.02 million. There were 15 active crushed stone operations, with 14 active quarries, in Alaska during 2022. The total value of sand and gravel produced in 2022 was \$65.2 million from 6.59 million tons of material. There were 78 active sand and gravel operations in Alaska during 2022, according to the USGS. These operations had 145 active pits and five dredging operations. The value and volume of

**Table 17.** Estimated mineral production in Alaska, 2020–2022<sup>a,b</sup>

Metals	Production Volume			Production value (\$)		
	2020	2021	2022	2020	2021	2022
Gold (ounces)	651,418	674,693	690,229	\$ 1,105,445,191	\$ 1,212,585,247	\$1,243,702,928
Silver (ounces)	17,997,209	16,714,807	15,768,899	321,364,224	419,708,804	342,973,553
Lead (tons)	128,875	127,208	107,089	199,206,769	254,416,000	207,752,660
Zinc (tons)	597,718	608,395	607,059	1,164,745,504	1,654,834,400	1,918,305,808
<b>Subtotal</b>				<b>\$ 2,790,761,688</b>	<b>\$ 3,541,544,451</b>	<b>\$3,712,734,949</b>
<b>Industrial Minerals</b>						
Sand and gravel (million tons)	6.7	6.2	6.6	\$ 56,900,000	\$ 54,400,000	\$65,200,000
Rock (million tons)	1.6	0.9	0.6	\$ 13,400,000	\$ 8,900,000	\$6,020,000
<b>Subtotal</b>	<b>8.3</b>	<b>7.0</b>	<b>7.2</b>	<b>\$ 70,300,000</b>	<b>\$ 63,300,000</b>	<b>\$71,220,000</b>
<b>Coal and Peat</b>						
Coal (tons) <sup>c</sup>	1,020,870	1,042,288	1,014,307	\$ 51,043,500	\$ 52,114,400	\$70,849,344
Peat (cubic yards)	–	–	–	–	–	–
<b>Subtotal</b>				<b>\$ 51,043,500</b>	<b>\$ 52,114,400</b>	<b>\$70,849,344</b>
<b>Total</b>				<b>\$ 2,912,105,188</b>	<b>\$ 3,656,958,851</b>	<b>\$3,854,804,293</b>

<sup>a</sup> Production data from DGGs questionnaires, Internet research, interviews with operators, DOT&PF, and municipalities, regional corporations, and Federal land management agencies.

<sup>b</sup> Values for selected metals, coal, and industrial minerals production are based on average prices for each year unless public values were provided by the operator. Total value does not match the Mining Revenue in Table 1 due to the incorporation of confidential data in the statewide total.

<sup>c</sup> Coal price assumption for revenue was updated from \$35 to \$50 per ton starting in 2020. This estimate is based on a coal price of \$3.37 per million BTU published for Alaska by the U.S. Energy Information Administration (<https://www.eia.gov/state/print.php?sid=AK>; last accessed November 15, 2021) and a heat value of 7,560 BTU per pound reported by Usibelli (<http://www.usibelli.com/coal/data-sheet>, last accessed January 13, 2022). 2020–2022 coal production for Usibelli coal mine was reported by MSHA (<https://arlweb.msha.gov/OpenGovernmentData/DataSets/MinesProdYearly.zip>).

Alaska's industrial minerals (rock, sand, and gravel) produced in 2022 is shown in figure 9 and tabulated in table 17 and appendix C.

The total estimated volume of industrial minerals sold from State-owned lands is 2.1 million tons. Sales of industrial minerals increased by 75 percent compared to the 1.2 million tons of sales volume in 2021. The sales volume value includes data from all three ADNR land offices (table 19), of which the Northern Region accounted for 92 percent of production from State of Alaska lands. The 2022 production volume, value, and employment figures should be considered minimum estimates due to reporting shortfalls. These figures do not account for significant production of industrial minerals on private, Native, and other Federal lands, as

tabulated by the USGS.

Gravel accounted for 44 percent of the total freight tonnage hauled by the Alaska Railroad in 2022. Construction along the rail belt in 2022 drove a 64% increase in gravel volume from 2021 levels, even though gravel tonnage was still 15 percent less than 2019 volumes. A good share of gravel hauling supported an Alaska Department of Transportation & Public Facilities project rehabilitating the Seward Highway, near Portage, from milepost 75 to milepost 90.

There were 451 active Application for Permits to Mine in Alaska (APMA) for placer mining in 2022 and an additional 97 APMA's for suction dredging. There were 95 active hardrock exploration APMA's.

**Table 18.** Production and employment estimates for Alaska placer gold mines, 2016–2022. Prior-year data for 2016–2021 are not updated in this table to maintain consistency with calculations and other tables in this report<sup>a</sup>

	2016	2017	2018	2019	2020	2021	2022
Number of placer operations reporting gross operating income <sup>a</sup>	205	192	169	150	148	148	140
Total gross operating income reported <sup>a</sup>	\$51,912,476	\$76,985,791	\$66,845,710	\$57,514,359	\$79,117,239	\$59,033,363	\$55,339,544
Average yearly price of gold <sup>b</sup>	\$1,250.74	\$1,257.12	\$1,268.49	\$1,392.60	\$1,769.64	\$1,797.24	\$1,801.87
Estimated number of gold ounces produced	41,505	61,240	52,697	41,300	44,708	42,391	40,712
Estimated number of full-time-equivalent	193	181	159	141	139	139	135

Estimated number of gold ounces produced is calculated by dividing the total gross income by the average price of gold. This yearly estimate does not take into account gold stockpiled, sold in other years, or paid as wages.

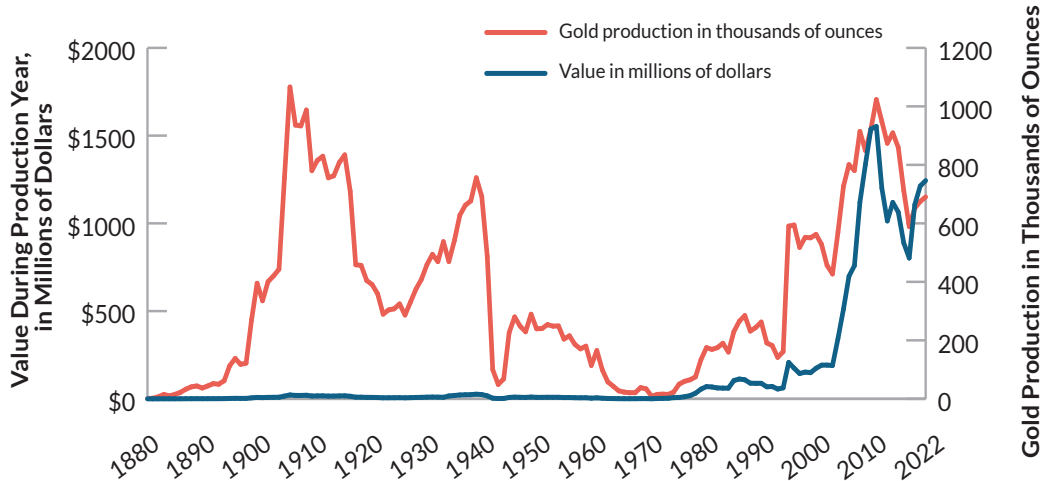
Estimated number of employees is calculated by multiplying the number of placer operations by 4 workers per mine, a factor determined for the October 2014 report *The Economic Impacts of Placer Mining in Alaska* prepared by McDowell Group, <https://www.dropbox.com/s/wly4yrnmlop59on/AMA%20Placer%20Final%20Report%2011.15.pdf?dl=0>. The factor takes in account unpaid family members and workers paid directly in gold. Full-time-equivalent jobs were calculated by multiplying the total number of workers by a ratio of 86 placer

miner working-days per year/365 days. The number of placer miner working-days per year was determined by McDowell Group for the October 2014 report.

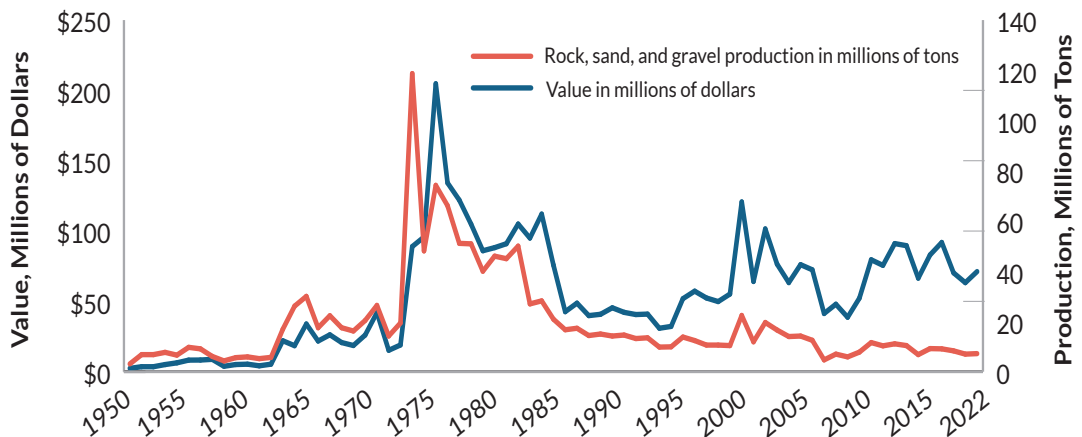
<sup>a</sup> Values provided by the Department of Revenue. Updated figures for prior years include: in TY 2016, 202 operations reported income of \$53,097,504; in TY 2017, 196 operations reported income of \$77,286,581; in TY 2018, 168 operations reported income of \$66,808,408; and in TY 2019, 154 operations reported income of \$58,144,314.

<sup>b</sup> 2016–2021 gold prices from Kitco cumulative average London PM fix.

**Figure 8.** Historical gold production in Alaska, 1880–2022, and corresponding market value.



**Figure 9.** Rock, sand, and gravel production in Alaska, 1950–2022.



**Table 19.** Material (rock, sand, and gravel) sale volumes (in tons) by region reported on State-owned land, excluding Mental Health Trust lands or lands managed by the State Pipeline Coordinator's Office, for 2014–2022. These volumes do not include material produced from private, Native, or Federal lands, which are significant amounts. These figures serve as minimum amounts of material produced

Regions	2014	2015	2016	2017	2018	2019	2020	2021	2022
Northern (Fairbanks office)	9,247,223	3,559,580	4,989,855	3,501,847	2,466,002	1,918,082	1,350,906	1,006,876	1,965,339
Southcentral (Anchorage office)	433,433	2,115,750	396,657	396,657	143,597	529,894	163,574	176,004	155,315
Southeast (Juneau office)	62,559	50,211	13,268	13,268	30,173	32,957	3,921	33,703	10,719
<b>Total Tons</b>	<b>9,743,214</b>	<b>5,725,541</b>	<b>5,399,780</b>	<b>3,911,772</b>	<b>2,639,771</b>	<b>2,480,933</b>	<b>1,518,401</b>	<b>1,216,583</b>	<b>2,131,373</b>

Source: Department of Natural Resources, Division of Mining, Land and Water Southeast Regional Office (SERO), South-Central Regional Office (SCRO), and Northern Regional Office (NRO) Material Sale Tracking Spreadsheets.

DNR material sales volumes and revenues do not correlate, as volumes are attributed to the calendar year in which material was extracted while revenues are tracked on a cash basis (when received), which could be in the subsequent calendar year.

The 2022 value of Alaskan mineral exports was \$2.75 billion, an increase of 3 percent from 2021 (table 20). Mineral and ore concentrates were worth \$2.11 billion, or 77 percent of the mineral export value. Minerals and ores are the second highest export sector for Alaska, after fish and marine products. Total exports include copper–gold concentrates from the Minto Mine in Yukon, Canada, shipped through the AIDEA-owned terminal in Skagway. Usibelli Coal Mine did not export coal outside of Alaska in 2022 (fig. 10). Alaska exported ores, concentrates, and other mining products to Canada worth \$576 million, to South Korea worth \$374 million, to Europe worth \$354 million, to Japan worth \$365 million, to China worth \$312 million, and to Australia worth \$41 million.

## Red Dog Mine

Red Dog Mine in Northwest Alaska is one of the largest sediment-hosted massive sulfide zinc deposits in the world. The mine is on lands owned by, and leased from, the NANA Regional Corporation, Inc., an Alaska Native Regional Corporation. It is operated by Teck Alaska Inc. as an open-pit, truck-and-loader operation that uses conventional drill-and-blast mining methods. Power for the mine is produced on-site by diesel generators with a maximum capacity of 30 megawatts. Mineral-processing facilities at the site employ conventional grinding and

sulfide-flotation methods to produce zinc and lead concentrates, which are transported to the coast for shipment during the summer season. Teck Alaska leases the road and port facilities from AIDEA.

The Red Dog deposit is comprised of several sedimentary hosted exhalative lead-zinc sulfide deposits hosted in Mississippian-age to Pennsylvanian-age sedimentary rocks. The orebodies are lens shaped and occur within structurally controlled (thrust faults) plates, are relatively flat-lying, and are hosted by marine clastic rocks (shales, siltstones, turbidites) and lesser chert and carbonate rocks. Barite-bearing rock is common in and above the sulfide units. Silicification is the dominant alteration type. The sulfide mineralization consists of semi-massive to massive sphalerite, pyrite, marcasite, and galena. Common textures within the sulfide zone include massive, fragmental, veined and, rarely, sedimentary layering.

The Red Dog Mine is the leading producer of zinc and lead in the United States. The mine is the second largest in the United States in terms of silver output.

Red Dog Mine consists of three ore bodies: Main (exhausted in early 2012), Aqqaluk (currently active), and Qanaiyaq (active; initial mining in 2017). 2022 year-end reserves and resources for the Aqqaluk and Qanaiyaq deposits

**Table 20.** Alaska international mineral export values (in millions of dollars)

Year	Mineral Ores and Concentrates <sup>a</sup>	Canada Copper Ores through Skagway Terminal <sup>b</sup>	Precious Metals <sup>c</sup>	Coal <sup>d</sup>	Total Value of Mineral Exports
1996	\$ 249	–	> \$1	\$ 27	\$ 276
1997	369	–	> \$1	26	395
1998	317	–	> \$1	8	325
1999	359	–	> \$1	15	374
2000	293	–	1	16	310
2001	329	–	3	17	349
2002	380	–	47	9	436
2003	413	–	84	4	501
2004	505	–	110	14	629
2005	511	–	132	14	657
2006	1,094	–	110	10	1,214
2007	1,269	16	132	5	1,406
2008	691	103	144	23	858
2009	853	64	153	33	1,039
2010	1,336	37	214	25	1,575
2011	1,809	199	267	31	2,107
2012	1,502	169	84	32	1,618
2013	1,495	150	22	27	1,543
2014	1,750	186	11	17	1,778
2015	1,467	99	7	5	1,479
2016	1,523	146	26	2	1,551
2017	1,794	1	13	0	1,807
2018	1,773	43	7	0	1,780
2019	1,637	33	274	0	1,911
2020	1,358	66	367	0	1,725
2021	2,126	79	544	0	2,670
2022	2,108	107	640	0	2,748

Sources: 1996–2013, 2018–2022, U.S. Census Bureau, Origin of Movement Series via USA Trade Online <https://usatrade.census.gov/>; 2014–2017, Alaska Office of International Trade.

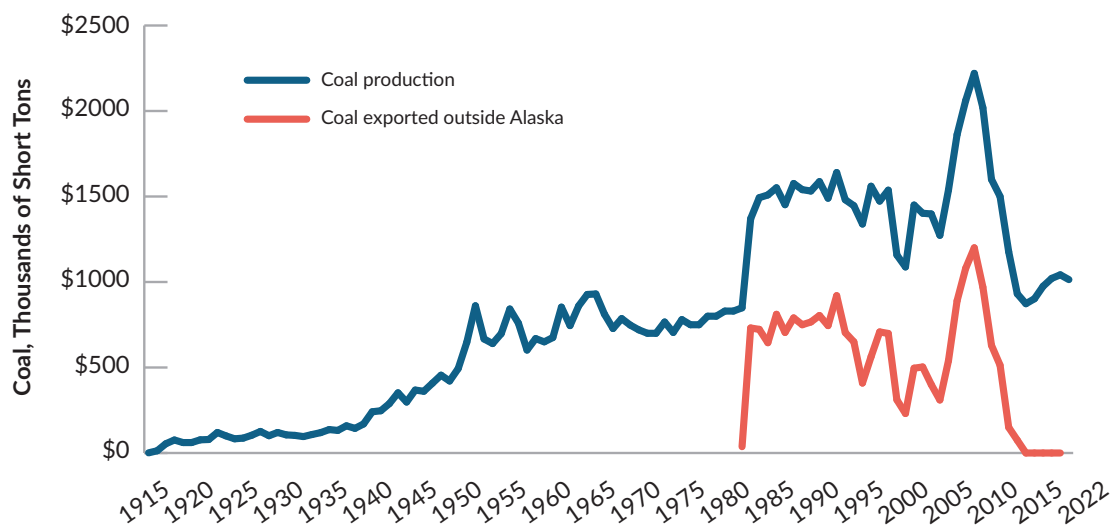
<sup>a</sup>HS 26 Mineral Ores: Zinc ores and concentrates, lead ores and concentrates, copper ores and concentrates, silver ores, gold ores and concentrates, zirconium ore (only in

2009), and miscellaneous ores.

<sup>b</sup>Value of Canada copper ores moving through Skagway that are included in Mineral Ores and Concentrates.

<sup>c</sup>HS 71 Precious Metals: Gold doré, precious stones, and wrought jewelry.

<sup>d</sup>HS 27 Coal.



**Figure 10.** Alaska coal production and exports, 1915–2022.

are tabulated in appendix D. During the first quarter of 2017, ore from the higher-grade Qanaiyaq deposit was introduced to supplement declining-grade ore from the Aqqaluk pit. Qanaiyaq ore is planned to make up about 20 percent of the mill feed through 2027. The current mine life, based on developed deposits, is expected to extend through to 2031.

The mining method is conventional open-pit drill-and-blast and truck-and-shovel technology. The mineral processing facilities employ conventional grinding and sulfide flotation methods to produce zinc and lead concentrates. Wet concentrates are trucked approximately 52 miles along the AIDEA's DeLong Mountain Transportation System to the port facilities on the Chukchi Sea coast.

Tailings storage and waste disposal areas have adequate design capacity to sustain the current life of mine plan. All contaminated water from the mine area and waste dumps is collected and contained in a tailings impoundment and seasonally discharged through a water treatment plant. Mill process water is reclaimed from the tailings pond.

Red Dog Mine directly employed approximately 600 full-time workers in 2022, with more than 100 contractors also working at the mine and associated facilities. Approximately 62 percent of employees at Red Dog Mine are NANA shareholders.

Red Dog Mine produced 609,516 tons of zinc during 2022, a nearly 10 percent increase over the 554,747 tons produced during 2021. The operation also produced 87,609 tons (173.5 million pounds) of lead, along with appreciable amounts of silver and germanium, though the amounts of the latter two metals were not reported by Teck.

The higher 2022 zinc output was a result of the higher-grade ore averaging 16 percent zinc compared to the 2021 ore that averaged 14.3 percent zinc. The zinc recovery was also slightly better than the 81.4 percent recovery rate

reported for 2021. Lead production was lower than in 2021 due to lower grade lead ore. The realized price per pound of zinc sold by Teck during 2022 was \$1.52. This price is roughly 9 percent higher than the \$1.39 per pound zinc price realized by the company in 2021.

The Red Dog Mine generated \$1.56 billion in revenue for Teck during 2022, a 40 percent increase over the \$1.16 billion in revenues during 2021. Teck's gross profit in 2022 from the Red Dog Mine was \$638.5 million compared with \$502.2 million in 2021. In accordance with the operating agreement between Teck and NANA, Teck pays a royalty on net proceeds of production each quarter. This royalty increases by five percent every fifth year, to a maximum of 50 percent. The most recent increase occurred in 2022, bringing the royalty to 40 percent. The NANA royalty expense in 2022 was \$353 million, compared with \$255 million in 2021. Approximately 60 percent of these royalties are ultimately redistributed to other Alaska Native Regional Corporations as dictated by section 7(i) of the Alaska Native Claims Settlement Act.

The 2022 Red Dog concentrate shipping season commenced on July 4, 2022. The shipping season was completed successfully on October 26, 2022. A total of 1,444,028 wet tons of zinc and lead concentrate were shipped in the 2022 season. Concentrate was safely transloaded from proprietary coastal barges onto 23 ships for delivery to global customers.

In 2022, most of the zinc concentrate produced at the Red Dog Mine was shipped to customers in Asia, Australia, and Europe, with the balance shipped to Teck's metallurgical facilities at Trail in British Columbia, Canada. Red Dog Mine's lead concentrate production was also shipped to Trail and to customers in Asia, Australia, and Europe. The Red Dog Mine zinc concentrate contains germanium, and the Trail refinery recovered undisclosed amounts of by-product germanium in the form of dioxide and tetrachloride.

Silver production was not reported for the

**Table 21.** Red Dog Mine production statistics, 1989–2022<sup>a</sup>

Year	Tons Milled	Ore Grade			Total Tons Concentrate Produced <sup>b</sup>	Contained Tons Zinc	Contained Tons Lead	Million Ounces Silver <sup>c</sup>	Employees <sup>d</sup>
		Zinc (%)	Lead (%)	Silver (oz/ton)					
1989	33,300	20.4	7.6	3.6	8,532	–	–	–	228
1990	996,700	26.5	8.5	3.6	443,600	191,981	31,187	1.6	350
1991	1,599,300	22.5	6.6	2.8	521,400	234,510	43,815	1.46	331
1992	1,582,000	19.9	6.0	2.9	474,900	231,363	15,960	1.38	349
1993	1,874,600	18.4	5.7	2.8	539,800	255,149	24,788	1.51	376
1994	2,339,500	18.8	5.7	2.8	658,000	328,160	32,775	1.84	391
1995	2,485,900	19.0	5.8	2.8	753,600	358,676	55,715	3.62	397
1996	2,312,600	18.7	5.0	2.8	765,300	357,680	65,886	4.3	417
1997	2,127,000	20.3	5.2	2.9	799,400	373,097	69,284	4.27	479
1998	2,752,587	21.4	5.2	2.7	1,015,773	490,461	80,193	5.2	466
1999	3,282,788	21.3	5.2	2.7	1,207,160	574,111	97,756	6.21	539
2000	3,365,508	21.0	4.7	2.5	1,211,539	585,030	91,557	5.84	536
2001	3,560,430	19.8	5.0	2.5	1,215,837	570,980	105,000	5.9	559
2002	3,489,600	21.1	5.4	2.7	1,366,480	637,800	118,880	6.75	560
2003	3,476,689	21.7	6.2	3.1	1,410,892	638,569	137,679	7.7	388
2004	3,249,613	22.0	6.0	3.0	1,337,545	610,900	128,970	7.22	508
2005	3,402,831	21.7	5.6	3.0	1,330,717	626,112	112,766	1.97	449
2006	3,569,280	20.6	6.1	3.0	1,378,384	614,538	136,135	7.62	457
2007	3,726,910	20.2	6.1	3.1	1,428,014	633,511	146,152	11.55	459
2008	3,306,934	20.1	6.0	3.1	1,273,885	567,911	135,143	7.5	475
2009	3,729,119	20.9	5.9	3.1	1,445,870	642,096	144,954	8.12	413
2010	3,937,456	18.2	5.4	3.1	1,300,694	593,043	121,144	6.78	550
2011	4,048,000	19.1	5.0	3.0	1,182,060	572,208	84,033	5.19	586
2012	3,941,000	18.2	4.6	3.0	1,134,415	529,157	95,282	5.89	530
2013	4,243,899	17.0	3.9	NA	1,271,221	607,704	106,594	6.1	550
2014	4,739,302	16.6	4.4	NA	1,409,511	656,971	135,032	7.56	639
2015	4,437,950	14.1	2.9	NA	1,351,221	625,004	129,630	6.7	630
2016	4,684,823	17.1	4.9	NA	1,411,029	642,647	134,813	7.34	600
2017	4,706,864	15.5	5.0	NA	1,322,302	597,342	122,687	7.7	715
2018	4,882,100	15.7	4.4	NA	1,371,264	642,868	108,467	7.0	700
2019	4,692,680	15.4	4.4	3.2	1,320,809	609,084	113,312	7.8	700
2020	4,625,293	14.2	4.0	NA	1,245,107	540,904	107,475	7.5	775
2021	4,771,660	14.3	4.2	NA	1,365,918	554,747	107,335	7.45	750
2022	4,485,140	16.0	3.7	NA	1,443,620	609,516	87,609	6.0	750
<b>Total</b>	<b>114,459,356</b>				<b>37,715,799</b>	<b>17,303,829</b>	<b>3,228,007</b>	<b>190.57</b>	

<sup>a</sup>Revised slightly from Special Report 51, *Alaska's Mineral Industry 1995*, based on new company data.

<sup>b</sup>Totals for years 1990 through 1995 include bulk concentrate. Total for 2013 estimated from total metal produced for 2013. Beginning in 2020, this value is the concentrate shipped for the production year, which ended October 26, 2022 for the 2022 production year.

<sup>c</sup>Estimate calculated at 56 ounces per ton of lead metal produced from 1990 to 2004 and 2006; as reported credit for 2005, net of treatment charges; calculated at 3.1 ounces per ton of ore for 2007; estimated as proportional

with increase in zinc and lead in 2013; as reported in 2014, 2016, 2017, and 2019; calculated based on recoverable silver from reported lead concentrate recovered in 2015; in 2018, 2020, 2021, and 2022 calculated from tons milled, the average grades and recoveries stated in the 2017 Red Dog 43-101 report, and the assumption that Aqqaluk and Qanaiyaq contributed 80% and 20%, respectively.

<sup>d</sup>Includes contract employees, if known.

– = No concentrate produced

NA = Not available

Red Dog Mine. Silver production recovered from Red Dog Mine concentrates is estimated by DGGs to be approximately 6 million ounces. By-product germanium recovered from zinc concentrates are also not disclosed but could be as high as tens of tons.

Red Dog Mine's production of contained metal in 2023 is anticipated to be in the range of 600,000 to 640,000 tons of zinc and 121,000 to 138,000 tons of lead. From 2024 to 2026, zinc production is expected to be in the range of 550,000 to 606,000 tons of contained zinc per year, while lead production is expected to be between 94,000 and 104,000 tons of contained lead per year.

Red Dog Mine is working closely with the Iñupiat community of Kivalina to address grievances related to perceived impacts of the operation on subsistence activities such as fishing and hunting. The Singagmiut Working Group was established as a collaborative forum to address subsistence-related concerns.

Teck is also funding a co-designed comprehensive human health study and a traditional land use study. Red Dog Mine continues to engage with the Kivalina IRA (Tribal Council) and through the Singagmiut Working Group.

## Fort Knox Mine

The Fort Knox Mine, a plutonic-hosted gold deposit, located 20 miles north of Fairbanks, is operated by Fairbanks Gold Mining Inc., a wholly owned subsidiary of Kinross Gold Corporation. The open-pit and truck-and-shovel operation, in its 26<sup>th</sup> year of operation, uses carbon-in-pulp, heap leach, and gravity processes to recover gold.

Fairbanks Gold Mine Inc. employed 732 people as of the end of 2022. Kinross Fort Knox had no lost time incidents. Employees worked over 1.5 million hours without a lost time incident.

The Fort Knox Mine main pit is nearing

the end of its mine life. The Gilmore project is a westward expansion of the Fort Knox pit. It is expected to add more than 2 million ounces of gold to the Fort Knox Mine's overall production and extend mine life to 2028. Total reserves and resources stood at 3.3 million ounces at year-end (app. D).

The Fort Knox Mine was the fourth largest gold producer in the United States during 2022 producing 291,249 gold equivalent ounces. Fairbanks Gold Mine Inc. mined 78.8 million tons of ore and waste from the Fort Knox pit with an average production rate of 215.8 thousand tons per day. The Fort Knox Mine mined 38.5 million tons of ore, processed 9.9 million tons through the mill and placed 55.12 million tons at the Barnes Creek Heap Leach Facility and approximately 373,200 thousand tons of ore on the Walter Creek Heap Leach Facility (table 22). Mill grade averaged 0.020 ounces of gold per ton with a 79.6 percent recovery rate. The heap leach grade averaged 0.006 ounces of gold per ton. Compared to 2021, tons mined increased by 60 percent, total tons processed (including ore placed on heap leach pads) increased by 57 percent, and mill feed grade did not change. These increases resulted from the planned mining sequence, with a focus on mining a higher proportion of leachable ore from Phase 9 and mill ore from the Gil Mine.

The Fort Knox Mine has seen a five-year increase in gold production (table 22). This upward trajectory reflects the early stages of the Kinross Alaska strategy, which is expected to see the annual gold output of the mill at Fort Knox Mine increase to roughly 400,000 ounces by 2025. The strategy is to leverage the underutilized mill, along with tailings storage space from more than 26 years of mining at Fort Knox Mine, to process ore from satellite deposits within a roughly 300-mile radius of the Interior Alaska operation. The implementation of this strategy began with mining at Gil, a satellite deposit on the Fort Knox property that is serving as a bridge to the first ore to be delivered from Manh Choh,

a much higher-grade deposit about 250 miles to the southeast.

Metal sales were \$521.7 million and increased in 2022 by 10 percent compared to 2021, due to the increase in gold equivalent ounces sold. Production cost of sales was \$350.7 million, and increased by 31 percent in 2022 compared to 2021, due to inflationary cost pressures on consumables, such as fuel, power

and reagents, higher contractor costs related to Gil mining, and the increase in gold equivalent ounces sold. Depreciation, depletion, and amortization expenses in 2022 were comparable to 2021 at \$109.7 million.

Production cost of sales was \$350.7 million in 2022, compared to \$267.2 million in 2021. Capital expenditures totaled \$86.3 million in 2022. Depreciation, depletion, and amortization

**Table 22.** Fort Knox Mine production statistics, 1996–2022

Year	Tons mined (ore+waste)			Tons Milled (ore)			Tons Placed on Heap Leach <sup>b</sup>	Ounces Gold Produced	Employees
	Fort Knox	True North <sup>a</sup>	Total	Fort Knox	True North <sup>a</sup>	Total			
1996	16,684,000	0	16,684,000	769,700	0	769,700		16,085	243
1997	32,380,000	0	32,380,000	12,163,151	0	12,163,151		366,223	249
1998	33,294,000	0	33,294,000	13,741,610	0	13,741,610		365,320	245
1999	30,350,000	0	30,350,000	13,819,010	0	13,819,010		351,120	253
2000	35,600,000	0	35,600,000	15,000,000	0	15,000,000		362,929	253
2001	25,957,900	8,448,400	34,406,300	13,282,614	2,377,386	15,660,000		411,220	360
2002	24,583,500	11,461,000	36,044,500	11,887,200	3,371,800	15,259,000		410,519	360
2003	30,597,940	12,707,100	43,305,040	11,473,000	3,611,682	15,084,682		391,831	316
2004	44,187,000	3,763,000	47,950,000	12,917,966	1,675,854	14,593,820		338,334	427
2005	63,248,000	0	63,248,000	14,384,842	0	14,384,842		329,320	411
2006	51,070,000	0	51,070,000	14,839,297	0	14,839,297		333,383	406
2007	45,940,000	0	45,940,000	14,021,400	0	14,021,400		338,459	399
2008	46,300,000	0	46,300,000	15,110,000	0	15,110,000		329,105	449
2009	27,585,000	0	27,585,000	17,884,000	0	17,884,000	3,746,800	263,260	500
2010	42,400,000	0	42,400,000	14,560,000	0	14,560,000	13,805,856	349,729	525
2011	34,550,000	0	34,550,000	14,880,000	0	14,880,000	19,367,650	289,794	522
2012	63,120,000	0	63,120,000	14,550,000	0	14,550,000	33,004,900	359,948	565
2013	63,280,000	0	63,280,000	13,960,000	0	13,960,000	32,785,602	428,822	629
2014	49,240,000	0	49,240,000	14,920,000	0	14,920,000	28,500,000	387,285	649
2015	60,860,000	0	60,860,000	14,820,000	0	14,820,000	27,700,000	401,553	657
2016	65,240,000	0	65,240,000	14,570,000	0	14,570,000	32,124,000	409,845	660
2017	60,450,000	0	60,450,000	13,744,703	0	13,744,703	22,340,517	381,115	627
2018	71,850,000	0	71,850,000	12,996,250	0	12,996,250	17,975,390	255,569	630
2019 <sup>c</sup>	27,962,298	0	27,962,298	8,905,562	0	8,905,562	20,373,996	200,263	655
2020 <sup>c</sup>	31,491,894	0	31,491,894	10,090,546	0	10,090,546	25,347,618	237,925	620
2021 <sup>c</sup>	38,527,022	0	38,527,022	8,881,018	0	8,881,018	32,883,680	264,283	650
2022 <sup>c</sup>	61,824,232	0	61,824,232	9,901,470	0	9,901,470	55,521,216	291,248	732
<b>Total</b>	<b>1,178,572,786</b>	<b>36,379,500</b>	<b>1,214,952,286</b>	<b>348,073,339</b>	<b>11,036,722</b>	<b>359,110,061</b>	<b>365,477,225</b>	<b>8,864,487</b>	

<sup>a</sup>True North Mine started production in 2001 and suspended production in 2004.

<sup>b</sup>Walter Creek heap leach facility started production in 2009. Barnes Creek

heap leach facility started production in 2020.

<sup>c</sup>Company reported ounces of gold produced in gold-equivalent ounces.

expenses totaled \$109.7 million.

The Fort Knox Mine met or exceeded all site level targets for permitting, water management, and closure planning. It has maintained its record of zero tailings breaches for the 30th consecutive year.

## Gil Mine

Kinross Gold Corp. opened the Gil Mine on September 23, 2021, becoming the sixth large-scale metal mine in Alaska. The Gil Mine is about eight miles east of the Fort Knox Mine complex. Gold mineralization at the Gil-Sourdough prospects was discovered in the 1980s, and Kinross acquired full ownership of the deposit in 2011. The Gil deposit consists of approximately 11 million tons of gold ore averaging 0.018 ounces of gold per ton, for a total of 193,000 gold ounces. It is part of the larger Gil-Sourdough resource area hosting 32.5 million tons of resource grading 0.016 ounces of gold per ton, for a resource of 533,000 ounces of gold.

The Gil Mine is expected to add 80 to 100 jobs while producing approximately 160,000 ounces of gold equivalent over a two-year mine life at an estimated cost of sales of approximately \$920 per gold equivalent ounce. The ore from the Gil deposit will be transported twelve miles east to the mill at Fort Knox Mine for processing, using existing roads on the Fort Knox property.

Alaska Aggregate Products LLC was contracted to do the mining at the Gil Mine. Gold production and costs associated with producing gold from the Gil Mine are reported as part of the Fort Knox Mine production statistics. Ore production commenced in the Main Gil Pit during October 2021. The mining contractor and Kinross mined 0.71 million tons of ore and waste from the Main Gil Pit in 2022, consisting of 2.973 million tons of mill ore, 0.231 million tons of leach grade ore, and 7.082 million tons of waste. Approximately 70,000 ounces of gold were produced from Gil Mine ore. Mining methods at the Gil Mine are similar to those at the Fort

Knox Mine, but smaller loading and haulage equipment is used. Loading, haulage, and mine support equipment is owned and operated by the mining contractor. Fort Knox Mine personnel perform drilling and blasting, and provide technical services support (e.g., mine planning, surveying, and ore control).

## Pogo Mine

Northern Star Resources' Pogo Mine in Interior Alaska near Delta Junction consists of a set of structurally controlled, gold-bearing quartz veins that are mined underground through a combination of long-hole open stoping and cut-and-fill mining methods. The on-site mill employs gravity, flotation, and cyanide-leaching processes to recover the gold.

Pogo Mine poured its four-millionth ounce of gold in 2020. Pogo Mine achieved a 20 percent increase in ore reserves to 7.26 million tons containing 1.808 million ounces of gold at an increased grade of 0.248 ounces of gold per ton during 2022. The combined indicated and inferred resources at the Pogo Mine are 24.6 million tons, grading 0.298 ounces of gold per ton, at a total of 7.3 million contained ounces of gold. This is the largest resource in the property's history (app. D).

The Pogo Mine had a full-time workforce of 600 people in 2022. Pogo Mine was the fifth largest gold producer in the United States in 2022.

The Pogo Mine consists of six underground gold deposits. The Liese system consists of at least four stacked flat to moderately dipping quartz veins. The South Pogo, Fun zone, and Central lodes are direct extensions of the Liese veins. The North zone consists of a series of steep, northeasterly dipping sheared quartz veins. The East Deep deposit is similar in strike and dip to the Liese system, although it has a higher sulfide content and thinner quartz veins.

Northern Star focused on conversion of resources to reserves in 2022 through an aggressive development drilling program. The

underground drilling equipment was converted from skid mounted to mobile carrier drill rigs. The mine had a fleet of 10 to 13 underground drill rigs.

Northern Star implemented a continuous improvement program with many fundamental changes to mining operations. The geology team focused on a fundamental geology first approach, with face and back mapping and sampling to build quality models. New systems, processes, and procedures were implemented, including waste management improvement, live information feed to resource team, and delivery speed of models to engineering.

Northern Star set a development target goal of 5,000 feet per month, with 70 ore and waste headings. Development crews set a quarterly record in mid-2022 by averaging 5,984 feet per month using seven mining jumbos. The

development rate was aided by a conversion from bolters for ground support to Jumbo Bolt mesh bolting.

Northern Star is also changing mining methods at Pogo Mine to produce more gold per year, with a stated target of 300,000 ounces of gold per year. The mine is being converted from a cut and fill operation to a longhole open-stopping operation. A conversion from centrifugal to positive displacement screw pumps for mine dewatering, and installation of a new shotcrete mixing bay were other infrastructure improvements implemented to reach production goals.

Northern Star sold 241,273 ounces of gold from the Pogo Mine at an all-in cost of \$1,702.49 per ounce during 2022. Gold recovered from the Pogo Mine during 2022 was 242,808 ounces. Ore mined during the year was

**Table 23.** Pogo Mine production statistics, 2006–2022

[opt = ounces of gold per ton]

Year	Tons Ore Mined	Tons Ore Milled	Ounces of Gold Recovered	Recovery (%)	Head Grade Gold (opt)	Employees <sup>a</sup>
2006	447,129	338,000	113,364	85.0	0.395	477
2007	715,665	715,400	259,820	84.4	0.430	339
2008	882,400	818,237	347,219	83.8	0.506	285
2009	944,823	930,836	389,808	88.2	0.475	272
2010	900,585	947,189	383,434	89.6	0.452	300
2011	892,725	929,020	325,708	89.6	0.392	310
2012	815,922	875,351	315,886	89.7	0.402	335
2013 <sup>b</sup>	963,229	875,351	337,393	90.2	0.395	320
2014	972,406	967,230	342,147	89.0	0.396	320
2015	–	–	283,000	–	–	350
2016	1,515,117	941,856	269,342	86.1	0.331	470
2017	1,602,107	974,940	271,273	88.1	0.314	470
2018 <sup>c</sup>	1,531,890	880,075	227,901	–	–	540
2019	875,298	902,373	154,589	–	–	650
2020	914,775	907,585	205,878	89.7	0.25	660
2021	948,630	991,928	188,316	86.0	0.20	507
2022	1,343,209	1,343,588	242,808	87.6	0.21	600
<b>Total</b>	<b>16,265,910</b>	<b>14,338,959</b>	<b>4,675,448</b>			

<sup>a</sup>Includes contract employees, if known.

<sup>b</sup>Silver production of 32,000 ounces was reported in 2013.

<sup>c</sup>Values are underreported due to the change in ownership to Northern Star Resources in 2018.

-- = Not reported

sourced from the Liese, South Pogo, and Fun zone areas. Pogo Mine ore had an average mined grade of 0.211 ounces of gold per ton and an average head grade of 0.210 ounces of gold per ton. Average gold recovery during 2022 was 87.6 percent, and 1,343,209 tons of ore were mined and 1,343,588 tons were milled.

During 2022, 918,279 dry tons of flotation tailings, 426,950 tons of mineralized rock, and 144,800 tons of non-mineralized rock were placed in the dry stack tailings facility. Approximately 231,637 dry tons of flotation tails and 90,540 dry tons of carbon in pulp tailings were placed underground as paste backfill in 2022. A survey of the dry stack tailings facility using a WingtraOne drone on September 5th, 2022, indicated 17.98 million tons of material were contained in the facility, representing 90 percent of the 20-million-ton design capacity.

### Manh Choh Project

Kinross Gold Corp. and Contango ORE Inc. continued the 70/30 Peak Gold JV at the Manh Choh gold–silver project, located on lands leased from the Native Village of Tetlin 11 miles south of Tok. The joint venture intends to develop an open-pit mine and truck the ore 250 miles to the Fort Knox mill near Fairbanks for processing. The skarn deposit hosts probable reserves of 1 million ounces of gold at an average grade of 0.230 ounces of gold per ton and 1.7 million ounces of silver at an average grade of 0.397 ounces of silver per ton, and indicated and inferred resources of 55.8 thousand ounces of gold at an average grade of 0.072 ounces of gold per ton and 0.21 million ounces of silver at an average grade of 0.271 ounces of silver per ton (app. D).

The Peak Gold JV approved an approximate \$26 million budget for 2022. The continuation of the federal and state permitting process, as well as on-going environmental monitoring, continued through the year. The project received a wetlands dredge and fill permit (USACE 404 permit), air quality minor permit, fish permits, water rights, and an amended application for

permit to mine during the year.

Project management firm KG Mining completed feasibility studies including economic and engineering details, environmental monitoring, community engagement along the route to Fort Knox Mine, and additional mineral exploration. During the development phase of this project, McKinley Research Group estimates that the Manh Choh project will generate \$50 million in direct labor income and about 280 new jobs over the construction period. It is estimated that the project will produce 485 jobs, considering direct, indirect, and induced employment.

Kinross Gold Corporation announced in July that its board of directors made a decision to proceed with development of the Manh Choh project. Kinross also released a combined feasibility study for the Fort Knox mill and the Peak Gold JV in July. The updated resource model included in the feasibility study adds 698,000 ounces of gold and 1.203 million ounces of silver to Kinross's probable mineral reserves. Kinross stated that the Manh Choh Mine is expected to produce 225,000 ounces of gold per year over 4.5 years, at an average cost of \$900 per ounce of gold. The feasibility study outlined the plan to batch process high-grade Manh Choh ore at the Fort Knox mill, with grades expected to be approximately 0.233 ounces of gold per ton, or 10 times the current average mill grade at Fort Knox Mine. By utilizing existing infrastructure, the Feasibility Study plan unlocks the project's value and avoids the construction of a mill or tailings facilities to reduce environmental disturbance at the project site.

Preliminary construction began in late 2022, with production of ore scheduled for late 2023. Mine development is expected to cost approximately \$180 million. About \$30 million of that amount is to purchase a fleet of highway-compliant, heavy bulk ore trucks to transport ore from the Manh Choh Mine to the Fort Knox Mine mill and processing facilities.

Non-sustaining capital expenditures at Manh Choh in 2022 were \$33.2 million.

Camp refurbishments were completed in advance of the construction season. The project purchased a closed hotel property in Tok with the intention of housing personnel during mining operations. A contractor worked through 2022 to refurbish and winterize (for year-round use) the existing facilities on the property (kitchen, dining, bedrooms, etc.) and install additional camp modules to house 175 personnel who do not live locally. All work was completed by the end of 2022.

The early works program progressed as planned. A five-acre construction laydown area was established, 7 miles of access road were constructed, and 125 acres were cleared of trees.

All long-lead procurement orders for both the Fort Knox mill modifications and the Manh Choh site were placed. An Alaska-based supplier for life of mine ore haul trucking was selected and a company with significant experience working in Alaska was awarded the contract mining. This contract will include initial construction along with mining and closure activities. Kinross focused on safely advancing the project, listening to stakeholder concerns, and building relationships with the local communities and the Native Village of Tetlin.

## Usibelli Coal Mine

Usibelli Coal Mine Inc. is a local, family-owned coal mining company that has operated in the Healy area since 1943. The company mines subbituminous coal from the Miocene Suntrana Formation, mainly from leases on State of Alaska land in the Hoseanna Creek and Jumbo Dome areas. There are four active and past coal resources: Two Bull Ridge, Gold Run Pass, Jumbo Dome, and Poker Flats. The company is currently mining Two Bull Ridge, which has more than 10 million tons of coal slated for production. The Two Bull Ridge resource has 3.5–5 cubic yards of overburden for each ton of coal, which is contained in multiple seams.

Number 3 seam averages 18 feet thick, Number 4 seam is up to 32 feet thick, and Number 6 seam averages 21 feet thick. Gold Run Pass is nearing completion of its mining life, with four of five reclamation stages complete. The Jumbo Dome mine region contains approximately 250 million tons of coal, of which about 80 million tons have been permitted. Number 4 seam averages 40 feet thick, with 25–75 feet of overburden above it, and Number 3 seam averages 30 feet thick with 35 feet of overburden between it and Number 4 seam. Stripping ratios are 0.5 cubic yards of overburden per one ton of coal. Poker Flats, now fully reclaimed, produced about 27 million tons of coal beginning in the 1970s.

In 2022, Usibelli Coal Mine produced 1,014,307 tons of coal from its Two Bull Ridge and Jumbo Dome mine sites. The majority of the coal from Usibelli Coal Mine is used for in-state electrical power generation, and cogeneration of electricity and heat, at Interior Alaska coal-fired power plants. In 2020, coal-fired plants accounted for 50 percent of electricity generation in the region, followed by naphtha (26 percent) and diesel (12 percent) fuel sources. In 2020, fuel costs averaged \$0.06 per kilowatt hour (kWh) at Golden Valley Electric Association's coal-fired plants, compared to \$0.15/kWh for diesel.

Coal from Usibelli Coal Mine accounted for 18 percent of the total freight tonnage on the Alaska Railroad in 2022. Coal volumes held steady in 2022, with just a slight dip in tonnage. Revenue from the haulage of coal from the Usibelli Coal Mine supports the nearly 700 Alaskans employed by the Alaska Railroad. In 2020, the mine spent \$28.4 million with more than 285 Alaska vendors to purchase goods and services.

Usibelli Coal Mine employed an average 98 workers in 2022, with about \$13 million in total payroll. Employment at Usibelli Coal Mine was stable over the year. About 85 percent of Usibelli Coal Mine jobs are based in Healy, with remaining jobs at the mine's offices in Fairbanks and Palmer. One hundred percent of the mine

employees are Alaska residents. The mine is Healy's largest year-round employer, and located in the Denali Borough.

Usibelli conducted a summer sampling program in 2022 to investigate the potential for critical minerals and REE in Healy-area coal. Usibelli drilled 13 holes of 4-inch core totaling approximately 2,000 feet through mineable coal seams. Standard proximate and ultimate analyses, along with geochemical sampling for critical minerals and REE, were conducted. One of the core holes was a twin of a hole drilled in 2019, and it was sent to the State of Alaska for detailed analysis of targeted intervals as part of the DOE-funded CORE-CM project. Handheld X-Ray Fluorescence analyses of core collected in this program will be compared to available geochemistry. Usibelli Coal Mine plans to use data and results to guide the future, targeted REE sampling and compositing protocols. Depending on the results, Usibelli will continue to investigate additional revenue sources from materials mined.

## Kensington Mine

The Kensington Mine is 45 miles north-northwest of Juneau, and is 100 percent owned by Coeur Alaska, Inc., a wholly-owned subsidiary of Coeur Mining, Inc. The mine is within the Berners Bay Mining District at the northernmost edge of the Juneau Gold Belt. Gold-bearing mesothermal, quartz, carbonate, and pyrite vein swarms and discrete quartz-pyrite veins are hosted in Cretaceous-aged Jualin diorite. Most of the gold is contained in calaverite ( $\text{AuTe}_2$ ) that occurs in association with native gold as inclusions in and interstitial to pyrite grains and in microfractures in pyrite. The underground Kensington Mine consists of at least three major, structurally controlled, orogenic-gold vein systems (Kensington Main, Jualin, and Raven), being mined by long-hole stoping and drift-and-fill methods, with gold recovered as a concentrate using flotation processes. Kensington Mine reserves totaled 409,000 ounces of gold as of December 31, 2022, and additional resources totaling 1.40 million ounces of gold are tabulated

in appendix D.

Coeur focused on several key projects for improved performance at the Kensington Mine. A new mine management operating system is expected to improve underground performance. Longer development rounds were implemented. Power plant work was also completed.

A total of approximately 261,431 tons of development rock was mined in 2022. Approximately 98,660 tons of development rock was brought to the surface and 162,771 tons were placed underground as backfill. Approximately 403,884 tons of tailings were conveyed to the tailings treatment facility and 249,090 tons of tailings were conveyed to the underground paste plant for disposal in the underground stopes during 2022.

Production and exploration core drilling totaled 208,877 feet. The drilling was completed by a contracted drilling company using NQ and HQ core drill tooling.

Coeur employed 400 people during 2022, not including the 50 contractors also working on-site. Contractors were primarily involved in drilling and camp services.

The mill processed 700,346 tons of material at an average grade of 0.17 ounces of gold per ton with an average 92.5 percent recovery rate (table 24). Approximately 17,480 tons of concentrate was shipped from the Kensington Mine to an off-site refinery.

Full-year production was 109,061 ounces of gold, a decline of 10 percent from 2021 due to mining lower grade ore and lower gold recovery (table 24). The Kensington Mine was ranked 14th among gold-producing operations in the United States in 2022.

Metal sales from Kensington Mine totaled \$202.5 million, a decline of 10 percent from metal sales in 2021. Costs applicable to sales for the year increased 31 percent to \$1,423 per ounce of gold compared to \$1,086 in 2021 due to lower production and higher costs related

to employees, maintenance, diesel and other consumables. Amortization decreased to \$39.0 million primarily due to less sold ounces and longer assumed mine life. Capital expenditures were \$31.5 million, with an increase from 2021 due to higher infill drilling footage and increased underground development.

Coeur Alaska received a final record of decision from the U.S. Forest Service for its Plan of Operations Amendment (POA) 1 on February 24, 2022. Coeur Alaska continued to work with state and federal agencies to obtain the remaining permits required to implement POA 1. POA 1 allows Coeur to increase tailings and waste-rock storage capacity with the anticipated extension of Kensington Mine's mine life by 10 years to 2033. Under the approved plan, Coeur intends to raise the height of Kensington Mine's existing tailings dam by 36 feet, which would increase tailings storage capacity by an additional 4 million tons. The company will also construct a 40-foot "back dam" between the Lower Slate Lake tailings treatment facility and Upper Slate Lake. Three existing waste rock storage facilities will be expanded, and one new waste rock storage facility

will be built. Total waste capacity is expected to increase by 5 million tons.

Kensington Mine has played a vital role in the southeast Alaska economy for decades. In addition to ranking as the second-largest private employer in the City & Borough of Juneau (after Hecla's Greens Creek Mine), Coeur was also the second-largest property taxpayer in 2022. In 2022, Coeur invested just under \$400,000 into community giving.

## Greens Creek Mine

The Greens Creek Mine, owned and operated by Hecla Greens Creek Mining Company, is a polymetallic, silver-rich VMS deposit located about 20 miles southwest of Juneau. Current mineral reserves and resources are listed in appendix D.

The 24 square mile Greens Creek property lies within the Admiralty Island National Monument. The underground mine has been in production since 1989, and it is accessed by a ramp from the surface. Mining is primarily by cut-and-fill and longhole stoping methods.

**Table 24.** Kensington Mine production statistics, 2010–2022  
[opt = ounces of gold per ton]

Year	Ore (tons milled)	Ore Grade Gold (opt)	Gold Recovery (%)	Gold Produced (oz)
2010 <sup>a</sup>	174,028	0.28	89.9	43,143
2011	415,340	0.23	92.7	88,420
2012	394,780	0.22	95.6	82,125
2013	553,717	0.21	96.6	114,821
2014	635,960	0.20	94.1	117,823
2015	659,786	0.20	94.9	128,865
2016	620,209	0.21	94.7	124,331
2017	668,727	0.18	93.5	115,094
2018	641,058	0.18	92.3	113,778
2019	658,378	0.21	91.0	127,914
2020	675,731	0.20	93.0	124,867
2021	667,560	0.19	93.2	121,140
2022	700,346	0.17	92.5	109,061
<b>Total</b>	<b>7,465,620</b>			<b>1,411,382</b>

<sup>a</sup>Production started July 3, 2010.

The 2,300 ton-per-day mill includes a semi-autogenous grinding (SAG) mill and ball mill grinding circuit, a gravity circuit to recover free gold and electrum, and a flotation circuit that produces three types of concentrates. Other related infrastructure includes a tailings storage area, a ship-loading facility, camp facilities, and a ferry dock. Hecla employed 491 workers at Greens Creek Mine in 2022.

The Greens Creek Mine is the leading producer of silver and the third largest producer of zinc in the United States. The mine is the sixth largest in the United States in terms of lead output, and ranked 20th in terms of gold production.

The Greens Creek Mine facilities processed 881,445 tons of ore in 2022, yielding 9.74 million ounces of silver, 48,216 ounces of gold, 52,312 tons of zinc, and 19,480 tons of lead (table 25). Silver accounted for 49 percent of the mine's revenue, followed by zinc with 26 percent, gold with 17 percent, and lead with 8 percent. Ore grades of milled metals were 13.64 ounces of silver per ton, 0.08 ounces of gold per ton, 2.68 percent lead, and 6.69 percent zinc. Production of all metals and ore grades were down from 2021 values largely due to mining easier to access, but lower-grade, ore because of mid-year manpower challenges.

Hecla had metal sales of \$335.1 million from Greens Creek Mine in 2022, yielding \$102.3 million in gross profit—a decrease of 60 percent from 2021—after production and sales costs, depreciation, depletion, and amortization. Gross profit decreased by \$69.4 million from \$171.7 million in 2021, as lower realized prices for all metals sold other than gold, and lower payable metal quantities sold compared to 2021, was further compounded by higher production costs reflecting inflationary pressures and more tons milled, and unfavorable changes in concentrate smelter terms. The total production cost per ton was \$196.73, an 11 percent increase from 2021, reflecting increased labor and maintenance costs as well as COVID-19-related

costs. The all-in sustaining cost of production, after byproduct credits, was \$5.77 per ounce of silver. Greens Creek Mine spent \$36.9 million on capital additions compared to \$23.9 million in 2021. Significant components of the 2022 capital additions were development of \$18.7 million, \$5.8 million in mobile equipment, \$4.9 million in additional camp housing and \$5.8 million in mine infrastructure.

The mill at the Greens Creek Mine generates approximately 2,100 dry short tons (DST) of filter-pressed tailings per day, or approximately 750,000 DST of tailings annually. Tailings are dewatered in a filter press, with about 50 percent being mixed with cement, and hauled underground for disposal in mined-out areas as backfill. The remaining tailings are transported in covered trailers from the mill and placed, using dry-stacking techniques, in the surface tailings disposal facility near Hawk Inlet in the upper reaches of the Tributary Creek drainage. In 2022, Hecla placed 420,388 tons of tailings and 65,499 tons of waste rock at the tailings disposal facility.

Underground definition and exploration drilling during 2022 focused on seven of the nine known mineralized zones on the property. Underground drilling achieved positive results focused on resource expansion and conversion. Three underground core drills worked on resource conversion in the 200 South and East ore zones, and on exploration in the East, 5250, 200 South, and Gallagher Fault Block zones. The mine plan at the end of 2022 included reserves and resources sufficient for approximately 12 years of production, through 2034 (app. D).

During the fourth quarter of 2022, the mine achieved record mill throughput of 2,500 tons per day. Expectations are to achieve 2,600 tons per day throughput over the next several years.

## Dawson Mine

The Dawson Mine is located on Prince of Wales Island in southeast Alaska, about 3.5 miles from the Hollis ferry terminal. Sundance Mining Group LLC operates the mine. The Dawson

**Table 25.** Greens Creek Mine production statistics, 1989–2022

Year	Tons Milled	Tons Concentrate	Metal Produced					Employees
			Tons Zinc	Tons Lead	Tons Copper <sup>a</sup>	Ounces Gold	Ounces Silver	
1989	264,600	–	187,007	9,585	–	23,530	5,166,591	235
1990	382,574	–	37,000	16,728	–	38,103	7,636,501	265
1991	380,000	–	41,850	16,900	–	37,000	7,600,000	238
1992	365,000	113,827	40,500	16,500	–	32,400	7,100,000	217
1993 <sup>b</sup>	77,780	–	9,500	3,515	–	7,350	1,721,878	217
1994 <sup>c</sup>	–	–	–	–	–	–	–	–
1995 <sup>c</sup>	–	–	–	–	–	–	–	–
1996 <sup>b</sup>	135,000	43,000	9,100	4,200	193	7,480	2,476,000	265
1997	493,000	–	46,000	19,000	1,300	56,000	9,700,000	275
1998	540,000	–	58,900	22,700	1,300	60,572	9,500,000	275
1999	578,358	–	68,527	25,503	1,400	80,060	10,261,835	275
2000	619,438	–	84,082	31,677	1,400	128,709	12,424,093	275
2001	658,000	–	63,903	22,385	1,400	87,583	10,900,000	275
2002	733,507	217,200	80,306	27,582	1,600	102,694	10,913,183	262
2003	781,200	–	76,200	24,800	–	99,000	11,707,000	295
2004	805,789	–	69,115	21,826	–	86,000	9,707,000	265
2005	717,600	–	58,350	18,600	–	72,800	9,700,000	265
2006	732,176	–	59,429	20,992	–	62,935	8,865,818	245
2007	732,227	–	62,603	21,029	–	68,006	8,646,825	276
2008	734,910	–	58,224	18,562	–	67,269	7,145,711	336
2009	790,871	–	70,379	22,253	–	67,278	7,459,170	321
2010	800,397	–	74,496	25,336	–	68,838	7,206,973	343
2011	772,069	–	66,050	21,055	–	56,818	6,498,337	364
2012	789,569	–	64,249	21,074	–	55,496	6,394,235	386
2013	805,322	–	57,614	20,114	–	57,457	7,448,347	390
2014	816,213	–	59,810	20,151	–	58,810	7,826,341	415
2015	814,398	–	61,934	21,617	–	60,566	8,452,153	418
2016	815,639	–	57,729	20,596	–	53,912	9,253,543	414
2017	839,589	–	52,547	17,996	–	50,854	8,351,882	423
2018	845,398	–	55,350	18,960	–	51,493	7,953,003	426
2019	846,076	–	56,805	20,112	–	56,625	9,890,125	426
2020	818,408	–	56,814	21,400	–	48,491	10,494,726	442
2021	841,967	–	53,648	19,873	–	46,088	9,243,222	450
2022	881,445	–	52,312	19,480	–	48,216	9,741,935	491
<b>Total</b>	<b>21,208,520</b>	<b>–</b>	<b>1,950,333</b>	<b>632,101</b>	<b>8,593</b>	<b>1,898,433</b>	<b>267,386,427</b>	

<sup>a</sup>No copper credits in 1989–1993 and 2003–2022.<sup>b</sup>Partial-year production.<sup>c</sup>No production in 1994 and 1995 due to mine closure.

– = Not reported

Mine exploits a medium-sized, low-sulfide, high-grade, free-milling gold–silver deposit. Veins are hosted by shale and siltstone of the Descon Formation, which locally contains sills and dikes. The quartz-vein system dips 28 degrees, and ore minerals include galena, chalcopyrite, sphalerite,

tellurides, and free gold. Ore occurs within a linear north-trending zone, which, from south to north, includes the past-producing Harris River Mine, Dawson Mine, Upper Crackerjack workings, and Puyallup Mine.

The Dawson Mine work schedule is three weeks on and two weeks off for mining crews and two weeks on and one week off for mill crews. The mine workforce of 54 people consists of 20 underground workers, 19 mill operations workers, 8 surface at underground workers, and 7 office workers at the minesite. Mining is done by typical room and pillar-updip-jackleg-slusher method, with rubber tired horizontal exploration and development entries and haulage-ways.

The Dawson Mine mill circuit uses gravity only separation with no chemicals. The 150-ton-per-day mill runs 24 hours per day, two weeks on, one week off schedule.

Production and other data for the Dawson Mine was not reported for 2022.

## Calder Mine

The Calder Mine is located on the northern end of Prince of Wales Island, 88 miles west of Ketchikan. It was developed as a dimensional marble quarry in the early 20th century. Although the marble is bright white, it didn't meet specifications for monuments or architecture, and the quarry closed after several years of operation. Toward the end of the century, the quarry was restarted by Sealaska Corporation to supply calcium carbonate to various industries. In 2011, Columbia River Carbonates purchased the property and began development and renovation of existing infrastructure.

The Calder Mine includes an open-pit calcium carbonate mine, loading/barge area, fueling station, shop area, and camp site. Additional site improvements include gravel access roadways, diesel power generators, and a potable water storage/treatment system.

Currently, Calder Mine has a proven ore reserve that is expected to last at least 75 years, with resource-expansion potential. The ore body is classified as being uniquely pure and yields uniform, bright white stone. The mine operates on a seasonal basis. Barges carry the stone to Columbia River Carbonates' plant in Woodland, Washington, where it is turned into a range of

wet and dry calcium carbonate products for use in paper, glass, plastics, paint, construction, agriculture, and other industries. Production data for 2022 was not reported.

## Nixon Fork Mine

The Nixon Fork Mine is a copper-gold skarn deposit located 32 miles northeast of McGrath and operated by Mystery Creek Resources, Inc., a wholly owned subsidiary of Titan Resources, Ltd. The Nixon Fork Mine is an underground cut-and-fill, shrinkage, and sub-level open stoping operation using gravity and flotation processes to recover copper concentrate, and carbon-in-leach process to recover gold. The property includes an 85-person camp. The last reported resources are approximately 145,000 tons, containing 136,000 ounces of gold.

Mystery Creek submitted a revised water treatment system description and cost estimate to the BLM and ADEC in 2021. No additional information has been made public.

Ownership of Mystery Creek Resources Inc. was transferred from Titan Resources Limited to Caribou Minerals Pty Ltd on August 13, 2021. Caribou is an Australian private company headquartered in Perth, Australia and owns 100 percent of Mystery Creek Resources and the Nixon Fork Mine.

## DRILLING

Twenty-three companies publicly reported drilling programs in Alaska in 2022 (table 26). Total drilling, including both publicly reported and confidential drilling footages, decreased 14 percent to 1,932,491 feet (table 27). Some of the drilling decrease is due to incomplete reporting. Development and production drilling totaled 1,858,047 feet. These large increases in pre-production drilling are likely due to changes in reporting methods. They may also account for increased activity.

Twenty-five individual projects reported 842,801 feet of exploration drilling in 2022, a decrease from 33 projects in 2021, as well as a 5 percent decrease in footage drilled. Reverse circulation (rotary) drilling totaled 71,655 feet in 2022. This is a 24 percent decrease from the 2021 reported hardrock rotary footage total.

Drilling footage was primarily compiled from questionnaires, public company reports, and online information, and represents a minimum amount for 2022. Production drilling is under-reported, and placer exploration drilling in 2022 was not compiled. Drilling for all phases of coal mining was not reported. Blast-hole drilling during production at Alaska's large lode mines was not tracked.

phone calls and provided information about their activities and operations. Without their voluntary and timely information, this report would not be possible. In addition to operational information, members of the public, industry, and agencies provided photographs used in this report. These contributions are greatly appreciated. Where appropriate, contributors have been acknowledged in the text.

The booklet's design, layout, and cover are by Kelsey Aho (DGGS). Travis Naibert and Erin Campbell reviewed the final version of this publication.

**Table 26.** Companies publicly reporting significant drilling programs in Alaska in 2022.

Ambler Metals LLC	Hecla Greens Creek Mining Company
American Pacific Mining Corp. (with Dowa Metals & Mining Alaska Ltd.)	HighGold Mining Inc.
Alaska Mental Health Trust Land Office	Kinross Gold Corp.
Coeur Alaska Inc.	Northern Star Resources Ltd.
Contango ORE	Nova Minerals Ltd.
Donlin Gold LLC	Peak Gold JV LLC
Felix Gold Ltd.	Resolution Minerals Ltd.
Flatlands Energy Corp.	Teck Alaska Inc.
Freegold Ventures Ltd.	Tectonic Metals Inc.
Grand Portage Resources Ltd.	Usibelli Coal Mine Inc.
Graphite One Inc.	Western Alaska Minerals Corp.
	Wiseman Metals

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The author thanks the companies, agencies, and individuals who responded to emails or

**Table 27.** Drilling footage reported or estimated in Alaska, 1982–2022

Year	Placer Exploration	Placer Thawing	Total Placer	Total Coal	Hardrock Core <sup>a</sup>	Hardrock Rotary <sup>a</sup>	Total Hardrock	Total Feet Drilled
1982	30,000	94,000	124,000	80,000	-	-	200,000	<b>404,000</b>
1983	23,000	30,000	53,000	12,000	-	-	180,500	<b>245,500</b>
1984	31,000	98,000	129,000	25,700	-	-	176,000	<b>330,700</b>
1985	46,000	34,000	80,000	8,700	-	-	131,700	<b>220,400</b>
1986	32,400	227,000	259,400	28,800	-	-	50,200	<b>338,400</b>
1987	50,250	130,000	180,250	19,900	95,600	19,500	115,100	<b>315,250</b>
1988	152,000	300,000	452,000	26,150	223,630	130,230	353,860	<b>832,010</b>
1989	97,250	210,000	307,250	38,670	242,440	89,790	332,230	<b>678,150</b>
1990	78,930	105,000	183,930	18,195	648,600	112,355	760,955	<b>963,080</b>
1991	51,247	130,000	181,247	16,894	205,805	110,850	316,655	<b>514,796</b>
1992	6,740	65,000	71,740	12,875	211,812	148,022	359,834	<b>444,449</b>
1993	25,216	-	25,216	-	124,325	127,990	252,315	<b>277,531</b>
1994	21,000	-	21,000	8,168	347,018	91,692	438,710	<b>467,878</b>
1995	27,570	-	27,570	-	363,690	51,795	415,485	<b>443,055</b>
1996	61,780	-	61,780	8,500	524,330	134,527	658,857	<b>729,137</b>
1997	38,980	-	38,980	13,998	523,676	180,834	704,510	<b>757,488</b>
1998	33,250	-	33,250	2,300	505,408	45,670	551,078	<b>586,628</b>
1999	6,727	-	6,727	-	369,863	78,934	448,797	<b>455,524</b>
2000	15,480	-	15,480	-	418,630	127,638	546,268	<b>561,748</b>
2001	1,100	-	1,100	36,151	240,318	75,750	316,068	<b>353,319</b>
2002	1,250	-	1,250	-	385,290	103,612	488,902	<b>490,152</b>
2003	10,108	-	10,108	2,000	270,456	100,178	370,634	<b>382,742</b>
2004	107,526	-	107,526	-	415,628	36,024	451,652	<b>559,178</b>
2005	3,360	-	3,360	-	592,497	41,780	634,277	<b>637,637</b>
2006	8,759	-	8,759	7,500	765,363	54,173	819,536	<b>835,795</b>
2007	19,575	-	19,575	50,539	830,478	268,112	1,098,590	<b>1,168,704</b>
2008	1,216	-	1,216	26,869	874,634	250,278	1,124,912	<b>1,152,997</b>
2009	1,244	-	1,244	W	403,275	260,059	663,334	<b>664,578</b>
2010	10,427	-	10,427	11,601	688,911	216,768	905,679	<b>927,707</b>
2011	3,150	-	3,150	W	883,272	175,181	1,058,453	<b>1,061,603</b>
2012	13,282	-	13,282	7,704	1,082,439	14,182	1,096,621	<b>1,117,607</b>
2013	17,986	-	17,986	W	933,194	17,800	950,994	<b>968,980</b>
2014	7,227	-	7,227	W	487,106	9,736	496,842	<b>504,069</b>
2015	-	-	-	W	923,324	12,795	937,769	<b>937,769</b>
2016	-	-	-	-	644,512	W	644,512	<b>644,512</b>
2017	-	-	-	W	1,016,731	W	1,016,731	<b>1,016,731</b>
2018	-	-	-	W	1,039,089	W	1,039,089	<b>1,039,089</b>
2019	-	-	-	W	812,933	35,267	848,200	<b>848,200</b>
2020 <sup>c</sup>	-	-	-	-	1,917,082	55,553	1,972,635	<b>1,972,635</b>
2021 <sup>c</sup>	-	-	-	-	2,157,974	94,655	2,252,629	<b>2,252,629</b>
2022 <sup>c</sup>	-	-	-	2,789	1,858,047	71,655	2,252,629	<b>1,932,491</b>

<sup>a</sup>Core and rotary drilling not differentiated prior to 1987.<sup>b</sup>Sonic drilling, generally minor footage overall, is included.<sup>c</sup>Changes in reporting of pre-production drilling at some sites explain the increase from 2019.

- = Not reported

W = withheld for confidentiality; included in hardrock rotary or core.

## APPENDIX A

### Resources Related to the Minerals Industry in Alaska



#### DEPARTMENT OF NATURAL RESOURCES

- Recording Fees – [dnr.alaska.gov/ssd/recoff/fees\\_RO.cfm](http://dnr.alaska.gov/ssd/recoff/fees_RO.cfm)
- Public Information Center – [dnr.alaska.gov/commis/pic/](http://dnr.alaska.gov/commis/pic/)
- State Uniform Commercial Code (UCC) Documents Search – [dnr.alaska.gov/ssd/recoff/ucc](http://dnr.alaska.gov/ssd/recoff/ucc)

#### Division of Mining, Land & Water

- Mining Applications and Forms – [dnr.alaska.gov/mlw/forms/](http://dnr.alaska.gov/mlw/forms/)
- Fact Sheets – [dnr.alaska.gov/mlw/factsht/](http://dnr.alaska.gov/mlw/factsht/)
- Annual Placer Mining Application (APMA) – [dnr.alaska.gov/mlw/mining/placer.cfm](http://dnr.alaska.gov/mlw/mining/placer.cfm)
- Annual Rental – [dnr.alaska.gov/mlw/cdn/pdf/factsheets/annual-rent.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/factsheets/annual-rent.pdf)
- Leasing State Land – [dnr.alaska.gov/mlw/cdn/pdf/factsheets/leasing-state-land.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/factsheets/leasing-state-land.pdf)
- Land Lease & Contract Payment Information – [dnr.alaska.gov/mlw/cdn/pdf/factsheets/land-lease-and-contract-payment-information.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/factsheets/land-lease-and-contract-payment-information.pdf)
- Production Royalty – [dnr.alaska.gov/mlw/cdn/pdf/factsheets/production-royalty.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/factsheets/production-royalty.pdf)
- DNR Production Royalty Form – [dnr.alaska.gov/mlw/cdn/pdf/forms/Production-Royalty-Form-2020-v2.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/forms/Production-Royalty-Form-2020-v2.pdf)
- Exploration Incentive Credit Program – [dnr.alaska.gov/mlw/cdn/pdf/factsheets/exploration-incentive-credit-program.pdf](http://dnr.alaska.gov/mlw/cdn/pdf/factsheets/exploration-incentive-credit-program.pdf)



#### Division of Geological & Geophysical Surveys

- Publications – [dggs.alaska.gov/pubs/](http://dggs.alaska.gov/pubs/)
- Interactive Maps – [maps.dggs.alaska.gov](http://maps.dggs.alaska.gov)
- Geologic Maps of Alaska: Online Map Search Tool – [maps.dggs.alaska.gov/mapindex/](http://maps.dggs.alaska.gov/mapindex/)
- Unpublished Geology-Related Data (Alaska Geologic Data Index) – [maps.dggs.alaska.gov/agdi/](http://maps.dggs.alaska.gov/agdi/)
- Geologic Materials Center – [dggs.alaska.gov/gmc/](http://dggs.alaska.gov/gmc/)
- Alaska Geochemistry Web Map – [maps.dggs.alaska.gov/geochem/](http://maps.dggs.alaska.gov/geochem/)
- Alaska Geospatial Council – [agc.dnr.alaska.gov/](http://agc.dnr.alaska.gov/)

#### Alaska's Minerals Data & Information Rescue in Alaska (MDIRA) Project Websites

- MDIRA Portal Home Page – [akgeology.info](http://akgeology.info)
- Alaska Mining Claims Mapper – [mapper.dnr.alaska.gov](http://mapper.dnr.alaska.gov)
- Land Records Web Application – [dnr.alaska.gov/landrecords](http://dnr.alaska.gov/landrecords)
- State Recorder's Office Search – [dnr.alaska.gov/ssd/recoff/searchRO.cfm](http://dnr.alaska.gov/ssd/recoff/searchRO.cfm)
- Alaska Resource Data File – [ardf.wr.usgs.gov](http://ardf.wr.usgs.gov)
- USGS Alaska Geochemical Database, Version 3.0 (NURE, RASS, PLUTO...) – [pubs.er.usgs.gov/publication/ds1117](http://pubs.er.usgs.gov/publication/ds1117)



#### DEPARTMENT OF COMMERCE, COMMUNITY, AND ECONOMIC DEVELOPMENT

- Community and Regional Information – [www.commerce.alaska.gov/web/dcra/ResearchAnalysis](http://www.commerce.alaska.gov/web/dcra/ResearchAnalysis)
- Alaska Industrial Development and Export Authority (AIDEA) – [www.aidea.org](http://www.aidea.org)
- AIDEA Supports Mining – [www.aidea.org/Programs/ProjectDevelopment/35YearsofMiningSupport.aspx](http://www.aidea.org/Programs/ProjectDevelopment/35YearsofMiningSupport.aspx)



#### DEPARTMENT OF REVENUE

- Mining License Tax – [www.tax.alaska.gov/programs/programs/index.aspx?60610](http://www.tax.alaska.gov/programs/programs/index.aspx?60610)
- Motor Fuel Tax Claim for Refund – [www.tax.alaska.gov//programs/programs/forms/index.aspx?60210](http://www.tax.alaska.gov//programs/programs/forms/index.aspx?60210)
- Alaska Motor Fuel Tax Instructions – [www.tax.alaska.gov/programs/documentviewer/viewer.aspx?5086f](http://www.tax.alaska.gov/programs/documentviewer/viewer.aspx?5086f)

## APPENDIX B

### Primary metals production in Alaska, 1880–2022<sup>a</sup>

Year	Gold <sup>b</sup>		Silver		Mercury		Antimony		Tin	
	(oz)	(m\$)	(oz)	(t\$)	(flask <sup>c</sup> )	(t\$)	(lb)	(t\$)	(lb)	(t\$)
1880–99	1,153,889	\$23.9	496,101	\$329.0	–	–	–	–	–	–
1900–09	6,673,173	137.9	1,324,580	779.5	–	–	–	–	304,000	\$112.2
1910–19	7,209,094	149.0	7,058,235	5,107.5	–	–	2,760,000	W	1,640,000	805.9
1920–29	3,373,336	69.8	6,407,375	5,160.8	117	\$7.6	W	W	317,800	163.9
1930–39	5,345,205	150.8	3,250,173	1,889.8	31	2.3	1,616,000	\$228.3	1,024,400	502.1
1940–49	3,137,447	109.8	794,842	577.0	3,094	724.3	2,062,080	311.1	319,200	230.3
1950–59	2,297,827	80.6	321,669	292.9	18,185	4,370.0	2,663,520	3,697.6	1,144,000	1,310.5
1960–69	751,870	26.6	59,300	70.7	13,996	3,098.0	228,800	267.8	–	–
1970–79	324,906	55.8	54,700	250.5	4,040	1,694.0	1,473,000	1,714.0	166,000	949.0
1980	75,000	32.0	7,500	111.0	–	–	–	–	120,000	984.0
1981	134,200	55.2	13,420	111.3	W	W	–	–	106,000	700.0
1982	175,000	69.9	22,000	198.0	–	–	–	–	198,000	1,365.0
1983	169,000	67.6	33,200	332.0	–	–	22,400	45.0	215,000	1,100.0
1984	175,000	62.1	20,000	159.0	5	1.5	135,000	225.8	225,000	400.0
1985	190,000	61.2	28,500	171.0	27	10.0	65,000	98.0	300,000	650.0
1986	160,000	60.8	24,000	134.4	12	2.8	45,000	67.5	340,000	890.0
1987	229,707	104.5	54,300	391.0	–	–	–	–	288,000	460.0
1988	265,500	112.8	47,790	282.0	W	W	–	–	300,000	950.0
1989	284,617	108.7	5,211,591	27,300.0	–	–	–	–	194,000	672.0
1990	231,700	89.2	10,135,000	50,675.0	–	–	–	–	57,000	200.0
1991	243,900	88.3	9,076,854	39,110.0	–	–	–	–	6,800	22.1
1992	262,530	88.5	9,115,755	34,913.0	–	–	–	–	1,500	5.9
1993	191,265	68.6	5,658,958	24,333.0	–	–	–	–	21,000	50.6
1994	182,100	70.3	1,968,000	10,391.0	–	–	–	–	–	–
1995	141,882	56.0	1,225,730	6,655.0	–	–	–	–	–	–
1996	161,565	62.6	3,676,000	19,078.0	–	–	–	–	–	–
1997	590,516	207.3	14,401,165	70,710.0	–	–	–	–	–	–
1998	594,191	174.6	14,856,000	82,154.0	–	–	–	–	–	–
1999	517,890	144.3	16,467,000	85,628.0	–	–	–	–	–	–
2000	551,982	154.1	18,226,615	90,404.0	–	–	–	–	–	–
2001	550,644	149.3	16,798,000	73,408.0	–	–	–	–	–	–
2002	562,094	174.3	17,858,183	82,326.0	–	–	–	–	–	–
2003	528,191	191.9	18,589,100	95,300.0	–	–	–	–	–	–
2004	456,508	192.3	16,947,270	113,056.9	–	–	–	–	–	–
2005	427,031	189.9	11,670,000	85,382.0	–	–	–	–	–	–
2006	570,129	344.1	16,489,394	190,415.9	–	–	–	–	–	–
2007	726,933	511.1	20,203,985	270,402.1	–	–	–	–	–	–
2008	800,752	698.2	14,643,735	219,496.4	–	–	–	–	–	–
2009	780,657	759.1	15,617,436	229,159.3	–	–	–	–	–	–
2010	914,462	1,119.8	13,991,297	282,523.5	–	–	–	–	–	–
2011	848,945	1,334.1	11,683,967	410,340.9	–	–	–	–	–	–
2012	921,240	1,537.5	12,313,877	383,573.6	–	–	–	–	–	–
2013	1,022,987	1,551.9	13,453,367	320,121.0	–	–	–	–	–	–
2014	948,547	1,201.2	15,388,901	304,392.5	–	–	–	–	–	–
2015	941,394	1,013.9	15,147,249	237,508.9	–	–	–	–	–	–
2016	909,242	1,119.3	16,621,035	246,109.8	–	–	–	–	–	–
2017	859,631	1,064.0	16,085,142	274,163.2	–	–	–	–	–	–
2018	711,986	888.3	15,116,355	210,826.8	–	–	–	–	–	–
2019	589,080	802.5	17,674,583	258,052.1	–	–	–	–	–	–
2020	651,418	1,105.4	17,997,209	321,364.2	–	–	–	–	–	–
2021	674,693	1,212.6	16,714,807	419,708.8	–	–	–	–	–	–
2022	690,229	1,243.7	15,768,899	342,973.6	–	–	–	–	–	–
Other <sup>e</sup>	489,537	–	–	–	1,438	–	–	–	–	–
<b>Total</b>	<b>52,370,623</b>	<b>\$21,147.2</b>	<b>476,810,144</b>	<b>\$5,928,304.0</b>	<b>40,945</b>	<b>\$9,910.5</b>	<b>11,070,800</b>	<b>\$6,655.1</b>	<b>7,287,700</b>	<b>\$12,523.5</b>

t\$ = thousands of dollars m\$ = millions of dollars -- = Not reported W = withheld

<sup>a</sup>From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used. Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

<sup>b</sup>Gold production adjusted to be more consistent with mining district production totals.

<sup>c</sup>76-lb flask.

<sup>d</sup>Crude platinum; total production of refined metal is about 575,000 oz.

<sup>e</sup>Not traceable by year

## APPENDIX B, CONTINUED

### Primary metals production in Alaska, 1880–2022<sup>a</sup>

Year	Lead		Zinc		Platinum <sup>d</sup>		Copper		Chromium	
	(tons)	(t\$)	(tons)	(t\$)	(oz)	(t\$)	(lb)	(m\$)	(tons)	(t\$)
1880–99	250	\$ 17.0	–	–	–	–	–	–	–	–
1900–09	369	32.8	–	–	–	–	29,549,486	\$ 4.8	–	–
1910–19	3,565	470.2	–	–	914	\$116.5	515,253,817	109.9	2,200	W
1920–29	7,961	1,084.1	–	–	5,750	484.9	643,576,929	93.3	–	–
1930–39	10,791	914.3	–	–	102,615	5,427.1	184,522,000	19.5	–	–
1940–49	3,096	405.2	678	\$ 0.5	225,285	12,623.3	433,700	0.2	7,409	\$ 250.9
1950–59	177	38.6	–	–	107,927	9,403.9	106,000	0.1	21,442	1,975.8
1960–69	40	9.9	–	–	111,556	13,618.5	352,000	0.1	–	–
1970–79	20	8.0	–	–	41,604	6,826.0	–	–	8,000	–
1980	31	29.0	–	–	–	–	–	–	–	–
1981	–	–	–	–	900	200.0	–	–	–	–
1982	–	–	–	–	W	W	–	–	–	–
1983	–	–	–	–	W	W	–	–	–	–
1984	–	–	–	–	W	W	–	–	–	–
1985	–	–	–	–	–	–	–	–	–	–
1986	–	–	–	–	W	W	–	–	–	–
1987	–	–	–	–	W	W	–	–	–	–
1988	–	–	–	–	25	13.8	–	–	–	–
1989	9,585	7,700.0	19,843	29,400.0	–	–	–	–	–	–
1990	44,220	30,954.0	181,200	253,680.0	–	–	–	–	–	–
1991	69,591	33,403.7	278,221	278,221.0	15	5.3	–	–	–	–
1992	68,664	31,585.0	274,507	301,957.7	–	–	–	–	–	–
1993	38,221	13,759.6	268,769	236,516.7	3	1.2	–	–	–	–
1994	36,447	25,512.9	329,003	296,102.7	5	2.1	–	–	–	–
1995	58,098	34,428.6	359,950	345,552.0	1	0.4	–	–	–	–
1996	70,086	52,284.0	366,780	361,646.0	2	0.8	780,000	0.8	–	–
1997	88,560	49,593.0	419,097	494,888.0	–	–	3,440,000	3.5	–	–
1998	102,887	49,386.0	549,348	505,400.0	–	–	3,800,000	2.9	–	–
1999	125,208	57,596.0	643,642	630,769.0	–	–	4,200,000	3.0	–	–
2000	123,224	51,754.0	669,112	682,494.0	–	–	2,800,000	2.3	–	–
2001	127,385	56,049.0	634,883	507,907.0	–	–	2,800,000	2.0	–	–
2002	146,462	61,514.0	718,103	502,674.0	–	–	3,200,000	2.3	–	–
2003	162,479	64,279.0	714,769	536,348.0	–	–	–	–	–	–
2004	150,796	120,636.8	680,015	651,432.2	–	–	–	–	–	–
2005	131,366	115,230.0	684,462	862,108.0	–	–	–	–	–	–
2006	157,128	183,629.3	673,967	2,002,971.4	–	–	–	–	–	–
2007	167,181	389,532.2	696,115	2,048,451.6	–	–	87,627	0.3	–	–
2008	153,705	287,428.4	626,135	1,055,220.1	–	–	–	–	–	–
2009	167,204	260,838.2	712,496	1,068,744.0	–	–	–	–	–	–
2010	146,480	284,171.2	667,539	1,212,390.3	–	–	–	–	–	–
2011	113,649	247,755.2	696,793	1,379,649.2	5,000	8,609.3	1,058	0.0	–	–
2012	126,234	234,795.2	647,481	1,139,566.6	–	–	14,327	0.0	–	–
2013	126,707	245,811.6	665,318	1,157,653.3	–	–	77,240	0.3	–	–
2014	155,183	294,847.2	716,781	1,404,890.4	–	–	–	–	–	–
2015	151,247	245,126.5	686,938	1,204,315.0	–	–	–	–	–	–
2016	155,409	241,931.4	700,376	1,250,186.4	–	–	–	–	–	–
2017	140,683	288,118.8	649,889	1,639,020.1	–	–	–	–	–	–
2018	127,427	252,176.4	698,218	1,851,779.3	–	–	–	–	–	–
2019	133,424	233,202.7	665,889	1,486,129.0	–	–	–	–	–	–
2020	128,875	199,206.8	597,718	1,164,745.5	–	–	–	–	–	–
2021	127,208	254,416.0	608,395	1,654,834.4	–	–	–	–	–	–
2022	107,089	207,752.7	607,059	1,918,305.8	–	–	–	–	–	–
Other <sup>e</sup>	–	–	–	–	71,946	17,091.9	–	–	–	–
<b>Total</b>	<b>3,964,412</b>	<b>\$5,209,414.4</b>	<b>19,109,488</b>	<b>\$32,115,949.2</b>	<b>673,548</b>	<b>\$57,333.1</b>	<b>1,394,994,184</b>	<b>\$245.3</b>	<b>39,051</b>	<b>\$3,426.7</b>

t\$ = thousands of dollars m\$ = millions of dollars -- = Not reported W = withheld

<sup>a</sup>From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used. Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

<sup>b</sup>Gold production adjusted to be more consistent with mining district production totals.

<sup>c</sup>76-lb flask.

<sup>d</sup>Crude platinum; total production of refined metal is about 575,000 oz.

<sup>e</sup>Not traceable by year

## APPENDIX C

Production of industrial minerals, coal, and other commodities in Alaska, 1880–2022<sup>a,b</sup>

Year	Coal		Sand and Gravel <sup>c</sup>		Rock <sup>d</sup>		Barite		Other <sup>e</sup>
	short tons	m\$	short tons	m\$	short tones	m\$	short tons	t\$	\$
1880–99	19,429	\$0.1	–	–	7,510	\$0.0	–	–	–
1900–09	33,214	0.2	–	–	15,318	0.2	–	–	\$246,403
1910–19	210,806	1.2	–	–	50,014	0.3	–	–	2,014,788
1920–29	937,860	5.2	–	–	494,417	2.7	–	–	2,523,754
1930–39	1,222,797	5.5	42,332	\$0.0	689,676	2.8	–	–	899,767
1940–49	3,189,026	20.2	1,758,504	0.7	286,341	1.3	–	–	27,124,158
1950–59	6,632,641	59.7	65,804,686	55.1	1,843,560	5.2	–	–	25,443,427
1960–69	7,849,000	58.8	163,315,000	176.7	2,034,000	4.2	225,000	\$1,200.0	34,143,000
1970–79	7,405,000	89.0	489,522,000	1,004.9	47,930,000	137.4	502,000	8,217.0	77,501,000
1980	800,000	16.0	40,000,000	86.0	3,700,000	15.4	50,000	2,000.0	97,500
1981	800,000	17.6	46,000,000	88.2	4,200,000	19.3	–	–	256,000
1982	830,000	18.0	45,000,000	91.0	3,400,000	15.6	–	–	150,000
1983	830,000	18.0	50,000,000	105.0	5,270,000	25.0	–	–	242,000
1984	849,161	23.8	27,000,000	95.0	2,700,000	16.0	–	–	875,875
1985	1,370,000	39.7	28,184,080	112.1	2,500,000	12.0	–	–	559,000
1986	1,492,707	40.1	20,873,110	75.8	4,200,000	20.3	–	–	384,800
1987	1,508,927	42.4	16,696,374	42.7	1,805,000	11.6	–	–	388,400
1988	1,551,162	44.3	17,264,500	48.8	3,600,000	24.7	–	–	389,000
1989	1,452,353	41.5	14,418,000	39.9	2,914,000	20.3	–	–	1,492,000
1990	1,576,000	45.0	15,013,500	40.8	3,200,000	22.1	–	–	400,000
1991	1,540,000	39.0	14,160,011	45.5	3,000,000	22.5	–	–	462,000
1992	1,531,800	38.3	14,599,746	42.2	2,900,000	23.0	–	–	430,000
1993	1,586,545	38.1	13,162,402	40.6	3,561,324	26.2	–	–	465,000
1994	1,490,000	36.8	13,518,321	41.0	3,843,953	27.0	–	–	459,500
1995	1,640,000	41.3	9,847,550	30.9	2,811,152	22.1	–	–	182,500
1996	1,481,000	38.0	9,890,463	32.2	3,000,045	23.6	–	–	200,000
1997	1,446,000	38.1	13,800,000	51.9	3,200,000	20.0	–	–	217,000
1998	1,339,000	35.2	12,363,450	57.3	1,636,200	14.0	–	–	215,000
1999	1,560,000	41.1	10,600,000	52.4	1,640,000	18.0	–	–	190,000
2000	1,473,355	38.8	10,600,000	49.9	5,200,000	36.6	–	–	203,000
2001	1,537,000	48.1	10,360,000	55.2	3,091,000	27.2	–	–	205,000
2002	1,158,000	37.4	22,412,000	120.7	3,152,000	31.4	–	–	200,000
2003	1,088,000	38.1	11,868,001	64.1	861,382	10.4	–	–	175,000
2004	1,450,000	50.8	19,576,092	101.5	7,312,050	106.2	–	–	2,732,554
2005	1,402,174	49.1	16,620,009	76.5	2,803,172	22.6	–	–	809,642
2006	1,397,500	48.9	13,953,465	63.4	2,369,738	23.8	–	–	1,057,500
2007	1,273,004	44.6	14,163,676	76.1	2,211,954	25.5	–	–	1,085,500
2008	1,538,000	53.8	12,461,685	72.4	2,485,820	39.5	–	–	1,159,502
2009	1,861,714	65.2	7,072,037	41.4	1,837,090	27.2	–	–	3,678,930
2010	2,061,000	72.1	6,977,297	48.0	290,852	4.3	–	–	2,303,950
2011	2,220,000	77.7	5,862,851	38.7	499,722	6.4	–	–	3,200,000
2012	2,018,759	70.7	7,799,994	52.3	1,050,762	15.8	–	–	–
2013	1,600,000	56.0	11,622,045	79.6	364,632	5.5	–	–	1,900,000
2014	1,500,000	52.5	9,215,300	63.2	1,147,869	17.2	–	–	120,000
2015	1,177,390	41.2	9,942,800	79.0	1,146,400	12.1	–	–	–
2016	930,987	32.6	9,557,000	74.3	825,630	15.3	–	–	–
2017	873,000	30.6	5,687,900	44.3	1,146,400	22.2	–	–	–
2018	1,000,000	35.0	7,639,000	55.2	1,543,200	27.8	–	–	–
2019	1,000,000	35.0	7,500,000	65.2	1,631,400	26.6	–	–	–
2020	1,020,870	51.0	6,724,000	56.9	1,554,300	13.4	–	–	–
2021	1,042,288	52.1	6,151,000	54.4	889,000	8.9	–	–	–
2022	1,014,307	70.8	6,590,000	65.2	596,000	6.0	–	–	–
Other	–	–	–	–	2,300,000 <sup>f</sup>	W	79,000	W	–
<b>Total</b>	<b>84,797,469</b>	<b>\$2,013.1</b>	<b>1,386,600,180</b>	<b>\$3,888.9</b>	<b>162,146,883</b>	<b>\$1,078.8</b>	<b>856,000</b>	<b>\$11,417.0</b>	<b>\$196,782,450</b>

<sup>a</sup>From published and unpublished State and Federal documents. Where State and Federal figures differ significantly, State figures are used.

<sup>b</sup>Please refer to previous editions of this appendix for year-to-year production information for years 1900 to 1979.

<sup>c</sup>As of 2015, rock, sand, and gravel are reported as a combined commodity.

<sup>d</sup>Building-stone production figures for 1880–1937 are for the south-central and interior regions of Alaska only.

<sup>e</sup>Includes 2.4 million lb U<sub>3</sub>O<sub>8</sub> (1955–1971); 505,000 tons gypsum (1905–1926); 286,000 lb WO<sub>3</sub> (intermittently, 1916–1980); 94,000 lb asbestos (1942–44); 540,000 lb graphite (1917–1918 and 1942–1950); and undistributed amounts of zinc, jade, peat, clay, soapstone, miscellaneous gemstones, and other commodities (1880–present).

<sup>f</sup>Marble quarried on Prince of Wales Island, southeastern Alaska (1900–1941).

m\$ = millions of dollars t\$ = thousands of dollars – = not reported W = withheld

## APPENDIX D

### Identified mineral resources of Alaska deposits

DEPOSIT - Type - Metal suite																
Phase	Category	Short Tons of Resources	Cu %	Cu thousand pounds	Pb %	Pb thousand pounds	Zn %	Zn thousand pounds	Au oz/ton	Au thousand ounces	Ag oz/ton	Ag thousand ounces	Mo %	Mo thousand pounds	Other grade %	Other quantity %
<b>SHUMAGIN (UNGA PROJECT) – Epithermal – Precious metals (gold, silver) Source: Redstar Gold Corp. news release dated February 10, 2020</b>																
Exploration (3.5 g/t cut-off)	Inferred	954,617							0.403	384.3	1.034	986.3				
<b>CENTENNIAL (UNGA PROJECT) – Epithermal – Precious metals (gold, silver) Source: Historical resource estimate by Battle Mountain Gold Company (1989), cited in Redstar Resources technical report on the Unga project, Southwest Alaska, USA; report dated June 14, 2018</b>																
Exploration	Inferred	4,780,000							0.042	200.0						
<b>KENSINGTON – Gold veins – Precious metals (gold) Source: Coeur Reports Year-End 2022 Mineral Reserves and Resources: Coeur Mining Annual Report dated February 14, 2023</b>																
Production	Proven	939,000							0.180	169.0						
Production	Probable	1,273,000							0.184	240.0						
Production	Measured	2,412,000							0.276	665.0						
Production	Indicated	1,309,000							0.293	384.0						
Advanced Exploration	Inferred	1,246,000							0.282	351.0						
	<b>Total</b>	7,179,000							0.251	1,809.0						
<b>LMS – Gold veins – Precious metals (gold) Source: NI 43-101 Technical Report on the LMS Gold Project, Goodpaster Mining District, Alaska; 43-101 technical report dated February 19, 2016</b>																
Exploration (0.5 g/t Au cut-off, open-pit)	Inferred	9,170,000							0.029	267.0						
Production (as of March 31, 2022)	Probable	7,264,223							0.248	1,800						
Production (as of March 31, 2022; includes Probable reserves)	Indicated	10,551,311							0.321	3,400						
Production (as of March 31, 2022)	Inferred	14,074,294							0.280	3,931						
	<b>Total</b>	24,625,605							0.298	7,331						
<b>TERRA – Gold veins – Precious metals (gold, silver) Source: Technical Report on Resources, Terra Gold Project, McGrath District, Alaska; 43-101 technical report dated February 19, 2013</b>																
Exploration (5 g/tonne Au cut-off)	Indicated	128,913							0.386	49.8	0.87	112.7				
Exploration (5 g/tonne Au cut-off)	Inferred	811,286							0.456	369.8	0.81	653.9				
	<b>Total</b>	940,199							0.446	419.6	0.82	766.6				
<b>HERBERT GOLD – Gold veins – Precious metals (gold) Source: Grande Portage Resources Ltd. news release dated May 21, 2021</b>																
Exploration (3 g/tonne Au cut-off)	Indicated	4,009,101							0.299	1,196.8	0.17	686.7				
Exploration (3 g/tonne Au cut-off)	Inferred	1,254,429							0.260	325.9	0.14	169.3				
	<b>Total</b>	5,263,530							0.290	1,522.7	0.16	856.0				
<b>GOLDEN ZONE – Gold veins – Precious metals (gold, silver) Source: Technical Report on the Golden Zone Property, Valdez Creek Mining District, Central Alaska Range, South-Central Alaska; NI 43-101 technical report dated November 23, 2016 / amended August 17, 2017</b>																
Exploration (0.5 g/tonne Au cut-off)	Indicated	4,615,377							0.058	267.4	0.303	1,397.8				
Exploration (0.5 g/tonne Au cut-off)	Inferred	1,491,427							0.024	35.9	0.075	111.4				
	<b>Total</b>	6,106,804							0.050	303.3	0.247	1,509.2				
<b>LUCKY SHOT (Willow) – Gold veins – Precious metals (gold) Source: Preliminary Feasibility Study for the Lucky Shot Project, Matanuska-Susitna Borough, Alaska, USA; NI 43-101 technical report dated June 30, 2016</b>																
Development (7 g/tonne cut-off; subset of measured)	Proven	75,728							0.551	41.7	0.059	4.5				
Development (7 g/tonne cut-off; subset of indicated)	Probable	116,513							0.394	45.8	0.041	4.8				
Exploration (5 g/tonne Au cut-off)	Measured	63,823							0.782	49.9	0.073	4.7				
Exploration (5 g/tonne Au cut-off)	Indicated	163,802							0.438	71.6	0.047	7.4				
Exploration (5 g/tonne Au cut-off)	Inferred	65,036							0.540	35.1	0.044	2.9				
	<b>Total (resources only)</b>	292,661							0.536	156.6	0.052	15.0				
<b>SHOTGUN – Gold veins – Precious metals (gold) Source: Technical Report on the Shotgun Gold Project, Southwest Alaska; NI 43-101 technical report dated May 27, 2013</b>																
Exploration (0.015 ounce of Au/ton cut-off)	Inferred	22,860,000							0.031	706.0						
	<b>Total</b>	22,860,000							0.031	706.0						
<b>DONLIN – Intrusion gold – Precious metals (gold) Source: NovaGold Resources, Inc. Donlin Creek Gold Project, Alaska, USA, NI 43-101 Technical Report; effective date June 1, 2021; NovaGold Resources Inc. Annual Report for the fiscal year ended November 30, 2022</b>																
Development	Proven	8,468,971							0.068	573.0						

Development	Probable	547,984,194			0.061	33,276.0		
Development	Measured	957,638,000			0.065	62.0		
Development	Indicated	76,481,004			0.071	5,497.0		
Development	Inferred	101,649,697			0.059	5,993.0		
	<b>Total</b>	<b>735,541,504</b>			<b>0.062</b>	<b>45,401.0</b>		
<b>FORT KNOX – Intrusion gold – Precious metals (gold) Source: Kinross Gold Corp. annual report dated February 10, 2023</b>								
Production	Proven	25,051,097			0.012	275		
Production	Probable	171,120,400			0.009	1,660		
Production	Measured	6,273,246			0.009	60		
Production	Indicated	109,871,647			0.009	1,032		
Production	Inferred	33,383,458			0.009	273		
	<b>Total</b>	<b>345,699,848</b>			<b>0.009</b>	<b>3,300</b>		
<b>GIL – Intrusion gold – Precious metals (gold) Source: Fort Knox Mine, Fairbanks North Star Borough, Alaska, USA; NI 43-101 technical report dated June 11, 2018; effective date: December 31, 2017</b>								
Production	Indicated	32,535,782			0.016	533.0		
Production	Inferred	4,438			0.014	63.0		
	<b>Total</b>	<b>32,540,220</b>			<b>0.016</b>	<b>596.0</b>		
<b>GOLDEN SUMMIT – Intrusion gold – Precious metals (gold) Source: Golden Summit Project Preliminary Economic Assessment, Fairbanks North Star Borough, Alaska, USA; 43-101 technical report dated January 20, 2016</b>								
Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Indicated	17,835,214			0.019	345.0		
Exploration (Dolphin oxide deposit; 0.30 g/tonne cut-off)	Inferred	10,604,126			0.017	183.0		
Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Indicated	49,912,144			0.020	1,018.0		
Exploration (Dolphin sulfide deposit; 0.30 g/tonne cut-off)	Inferred	68,210,324			0.020	1,401.0		
	<b>Total</b>	<b>146,561,808</b>			<b>0.020</b>	<b>2,947.0</b>		
<b>GRANT MINE (Ester Dome) - Intrusion gold - Precious metals (gold) Source: Felix Gold Ltd., <a href="https://felixgold.investorportal.com.au/mineral-resources/">https://felixgold.investorportal.com.au/mineral-resources/</a>; Conforms to JORC Code 2012, Effective date June 30, 2021</b>								
Exploration	Open-Pit	5,647,530			0.040	227.9		
	Underground	751,895			0.181	136.1		
	<b>Total</b>	<b>6,399,424</b>			<b>0.057</b>	<b>364.0</b>		
<b>MANH CHOH – Main and North Peak Skarn – Precious metals (gold, silver, copper) Source: Kinross Gold 2022 second-quarter report dated July 27, 2022.</b>								
Development	Probable	4,337,157			0.230	997,962.5	0.397	1,719,838.9
Development	Measured	0			0.000	0.0	0.000	0.0
Development	Indicated	755,657			0.071	53,397.8	0.274	206,750.8
Development	Inferred	22,040			0.111	2,445.6	0.267	5,888.6
	<b>Total</b>	<b>5,114,854</b>			<b>0.206</b>	<b>1,053,805.8</b>	<b>0.378</b>	<b>1,932,478.4</b>
<b>MONEY KNOB (Livengood) – Intrusion gold – Precious metals (gold) Source: Pre-Feasibility Study of the Livengood Gold Project, Livengood, Alaska, USA; 43-101 technical report dated December 17, 2021</b>								
Advanced Exploration	Proven	453,473,000			0.019	8,492.0		
Advanced Exploration	Probable	20,387,000			0.025	512.0		
Advanced Exploration	Measured	711,892,000			0.018	12,482.5		
Advanced Exploration	Indicated	64,478,020			0.018	1,141.6		
Advanced Exploration	Inferred	17,609,960			0.012	207.0		
	<b>Total</b>	<b>793,979,980</b>			<b>0.017</b>	<b>13,831.1</b>		
<b>NIXON FORK – Intrusion gold (skarn) – Precious metals (gold) Source: Technical Report on the Nixon Fork Mine Project, Medfra Quadrangle, Alaska; NI 43-101 technical report dated February 3, 2012</b>								
Development (past producer; lode, 5 g/tonne cut-off)	Indicated	270,427			0.481	130.0		
Development (past producer; lode, 5 g/tonne cut-off)	Inferred	118,200			0.512	60.5		
Development (past producer; tailings, 5 g/tonne cut-off)	Indicated	101,412			0.230	23.3		
Development (past producer; tailings, 5 g/tonne cut-off)	Inferred	52,910			0.210	11.4		
	<b>Total</b>	<b>542,949</b>			<b>0.414</b>	<b>225.2</b>		
<b>VINASALE – Intrusion gold – Precious metals (gold) Source: Technical Report for the Vinasale Mountain Prospect, McGrath Mining District, Alaska; 43-101 technical report dated March 31, 2013</b>								
Exploration	Indicated	3,760,000			0.043	162.0		
Exploration	Inferred	55,340,000			0.031	1,703.0		
	<b>Total</b>	<b>59,100,000</b>			<b>0.032</b>	<b>1,865.0</b>		

ILLINOIS CREEK — Intrusion gold-silver-copper — Precious metals (gold, silver) Source: Western Alaska Copper and Gold website ( <a href="https://www.wacg.rocks/projects/illinois-creek/">https://www.wacg.rocks/projects/illinois-creek/</a> ; accessed August 31, 2020)													
Advanced Exploration	Indicated	7,450,000	0.18	26,820					0.030	226.0	1.00	7,500	
Advanced Exploration	Inferred	2,240,000	0.22	9,856					0.031	70.0	1.13	2,500	
	<b>Total</b>	<b>9,690,000</b>	<b>0.19</b>	<b>36,676</b>					<b>0.031</b>	<b>296.0</b>	<b>1.03</b>	<b>10,000</b>	
NAOSI — Intrusion gold — Precious metals (gold) Source: Internal resource calculation presented to the American Exploration and Mining Association annual meeting, December 2019.													
Exploration Oxide (0.0102 oz/ton cut-off)	Indicated	11,697,714							0.049	576.0	0.79	9,274	
Exploration Sulfide (0.0146 oz/ton cut-off)	Indicated	6,715,193							0.063	421.0	0.82	5,498	
Exploration Oxide (0.0102 oz/ton cut-off)	Inferred	9,307,906							0.030	277.0	0.41	3,852	
Exploration Sulfide (0.0146 oz/ton cut-off)	Inferred	2,200,211							0.035	75.0	0.65	1,419	
Exploration Mon Ridge and Lone Wolf (0.0102 oz/ton cut-off)	Inferred	5,173,141							0.043	222.0	0.39	2,027	
	<b>Total</b>	<b>35,094,165</b>							<b>0.042</b>	<b>1,571</b>	<b>0.65</b>	<b>22,070</b>	
KORBEL — Intrusion gold — Precious metals (gold) Source: Nova Minerals Ltd. news release dated December 23, 2021													
Exploration (0.15 g/t cut-off, Korbel Main)	Indicated	315,260,660							0.009	3,000.0			
Exploration (0.15 g/t cut-off, Korbel Main)	Inferred	642,646,730							0.009	5,100.0			
Exploration (0.30 g/t cut-off, RPM North)	Inferred	25,353,130							0.058	1,500.0			
	<b>Total</b>	<b>983,260,520</b>							<b>0.010</b>	<b>9,600</b>			
DELTA — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Bedrock Geologic Map of the Delta Mineral Belt, Tok Mining District, Alaska (DGGS PR 122); 2003													
Exploration (DW/Mid/Nunatak/LP)	Inferred	9,400,000	0.4	75,200	1.75	329,000	4.61	866,680	0.047	441.9	1.85	17,402	
Exploration (PP2)	Inferred	5,900,000	0.4	47,200	2.1	247,800	4.6	542,800	0.050	292.9	2.07	12,232	
Exploration (DDS)	Inferred	2,300,000	1.1	50,600	2.6	119,600	6.5	299,000	0.070	161.2	2.98	6,850	
Exploration (DDN)	Inferred	1,200,000	1.6	38,400	2.4	57,600	2.3	55,200	0.093	112.1	2.98	3,574	
	<b>Total</b>	<b>18,800,000</b>	<b>0.6</b>	<b>211,400</b>	<b>1.9</b>	<b>754,000</b>	<b>4.5</b>	<b>1,763,680</b>	<b>0.048</b>	<b>1,008.1</b>	<b>1.96</b>	<b>40,058</b>	
RED MOUNTAIN/BONNIFIELD — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Maiden JORC Mineral Resource at White Rock's Red Mountain zinc-silver Project, Alaska; White Rock Minerals Ltd. news release April 26, 2017, 2022													
Exploration (Dry Creek; 1% Zn cut-off)	Inferred	15,648,400	0.1	41,876	1.0	321,784	2.9	892,620	0.015	212	1.28	20,100	
Exploration (West Tundra Flats; 3% Zn cut-off)	Inferred	7,385,486	0.1	15,432	2.8	414,469	6.2	917,123	0.032	229	5.51	40,800	
Exploration (Dry Creek Copper Zone; 0.5% Cu cut-off)	Inferred	440,800	1.1	8,816	0.03	220	0.2	1,763	0.003	1	0.12	50	
	<b>Total</b>	<b>23,474,686</b>	<b>0.1</b>	<b>66,124</b>	<b>0.7</b>	<b>736,473</b>	<b>1.9</b>	<b>1,811,506</b>	<b>0.010</b>	<b>442</b>	<b>0.86</b>	<b>60,950</b>	
GREENS CREEK — Massive sulfide — Polymetallic (lead, zinc, gold, silver) Source: Hecla Mining Company 2022 Annual Report													
Production	Proven	6,700			2.30	300	5.40	720	0.070	0.4	16.10	108	
Production	Probable	10,667,600			2.50	529,200	6.50	1,389,600	0.090	934.7	10.90	116,748	
Production	Measured												
Production	Indicated	8,421,200			2.90	491,980	8.00	1,351,480	0.100	810.3	12.90	108,717	
Production	Inferred	2,383,200			2.80	134,800	6.90	328,160	0.070	178.1	12.10	28,949	
	<b>Total</b>	<b>21,478,700</b>			<b>2.69</b>	<b>3,069,960</b>	<b>7.13</b>	<b>3,069,960</b>	<b>0.092</b>	<b>1,923.5</b>	<b>11.82</b>	<b>254,522</b>	
NIBLACK — Massive sulfide — Polymetallic (copper, zinc, gold, silver) Source: Mineral Resource Estimation, Niblack Polymetallic Sulfide Project, Alaska, U.S.A.; technical report dated December 5, 2011													
Advanced Exploration (Lookout deposit)	Indicated	6,215,000	0.95	118,085			1.73	215,039	0.051	318.0	0.86	5,357	
Advanced Exploration (Lookout deposit)	Inferred	2,612,000	0.73	38,135			1.17	61,121	0.041	108.0	0.63	1,650	
Advanced Exploration (Trio deposit)	Inferred	1,128,000	1.00	22,560			1.56	35,194	0.032	37.0	0.48	545	
	<b>Total</b>	<b>9,955,000</b>	<b>0.81</b>	<b>178,780</b>			<b>1.29</b>	<b>311,354</b>	<b>0.039</b>	<b>384.0</b>	<b>0.59</b>	<b>5,843</b>	
											<b>Barite (%)</b>	<b>Thousands of pounds</b>	
Exploration (RW & South Wall Zones; \$75/tonne cut-off)	Indicated	5,155,504	1.49	154,000			5.23	539,000	0.009	45.1	0.899	4,600	
Exploration (RW & South Wall Zones; \$75/tonne cut-off)	Inferred	5,884,131	0.96	113,000			5.20	612,000	0.008	48.1	0.853	5,000	
Exploration (AG Zone; 5.0% zinc-equivalent cut-off)	Inferred	4,691,431	0.12	11,000	0.96	90,000	4.64	435,000	0.016	72.5	3.489	16,400	
	<b>Total</b>	<b>15,731,066</b>	<b>0.9</b>	<b>278,000</b>	<b>0.3</b>	<b>90,000</b>	<b>5.04</b>	<b>1,586,000</b>	<b>0.011</b>	<b>166</b>	<b>1.65</b>	<b>26,000</b>	
												<b>23.9</b>	<b>2,464,765</b>
												<b>22.0</b>	<b>2,588,224</b>
												<b>34.8</b>	<b>3,262,838</b>
												<b>26.4</b>	<b>8,315,827</b>
JOHNSON TRACT — Massive sulfide — Polymetallic (copper, lead, zinc, gold, silver) Source: Updated Mineral Resource Estimate and NI 43-101 Technical Report for the Johnson Tract Project, Alaska; 43-101 technical report dated August 25, 2022.													
Exploration (3.0 g/t gold-equivalent cutoff)	Indicated	384,595,959	0.56	43,100	0.67	51,500	5.21	400,800	0.156	598.0	0.18	673	
Exploration (3.0 g/t gold-equivalent cutoff)	Inferred	778,231	0.59	9,200	0.30	4,700	4.18	65,100	0.040	31.0	0.27	207	
	<b>Total</b>	<b>385,374,190</b>	<b>0.56</b>	<b>52,300</b>	<b>0.67</b>	<b>56,200</b>	<b>5.21</b>	<b>465,900</b>	<b>0.155</b>	<b>629.0</b>	<b>0.18</b>	<b>880</b>	

RED DOG – Massive sulfide – Base metals (lead, zinc, silver) Source: Reserves and resources as of December 31, 2021. <a href="https://www.teck.com/media/2022-AIF.pdf">https://www.teck.com/media/2022-AIF.pdf</a> , accessed on April 3, 2024														
Production (Aqqaluk, Qanaiyaq)	Probable	47,289,099			3.6		12.6	9,942,836			1.96	53,130		
Production (Aqqaluk, Qanaiyaq)	Indicated	10,031,021			5.0		7.5	1,504,653			2.52	25,278		
Production (Aqqaluk, Qanaiyaq)	Inferred	10,141,252		872,148	4.3		12.4	2,515,030			2.56	25,941		
<b>Total</b>		67,461,372			3.9		11.8	13,962,520			2.13	104,348		

ANARRAAQ – Massive sulfide – Base metals (lead, zinc, silver) Source: Reserves and resources as of December 31, 2021. <a href="https://www.teck.com/media/2022-AIF.pdf">https://www.teck.com/media/2022-AIF.pdf</a> , accessed on April 3, 2024														
Exploration	Inferred	21,384,814			4.2		14.4	6,158,826			2.14	45,834		
Exploration (barite grade unspecified)	Inferred	1,100,000,000									?	?	Barite (%)	Thousands of pounds

LIK – Massive sulfide – Base metals (lead, zinc, silver) Source: S-K 1300 Technical Report Summary, Lik Project, Northwest Arctic Borough, Alaska, USA, Solitario Zinc Corp.; dated March 11, 2022														
Advanced Exploration (Lik South, 5% Zn+Pb cut-off)	Indicated	18,849,501			2.69		8.04	3,031,000			1.46	27,520		
Advanced Exploration (Lik North, 5% Zn+Pb cut-off)	Indicated	562,178		27,659	2.46		8.95	100,630			1.54	868		
Advanced Exploration (Lik South, 5% Zn+Pb cut-off)	Inferred	782,640		30,836	1.97		7.78	121,779			0.42	327		
Advanced Exploration (Lik North, 5% Zn+Pb cut-off)	Inferred	2,303,828		137,308	2.98		8.93	411,464			1.38	3,175		
<b>Total</b>		22,498,147			2.69		8.14	3,664,872			1.42	31,891		

ARCTIC – Massive sulfide – Polymetallic (copper, lead, zinc, gold, silver) Source: Arctic Feasibility Study, Alaska, USA, NI 43-101 Technical Report; dated August 20, 2020														
Advanced Exploration (in pit, 0.5% Cu-equivalent cut off)	Probable	47,887,653	2.24	2,145,367	0.54	517,187	3.12	2,988,190	0.014	657.2	1.01	48,522		
Advanced Exploration (in pit, 0.5% Cu-equivalent cut off)	Inferred	3,858,085	1.71	131,000	0.60	47,000	2.72	210,000	0.011	40.0	0.84	3,000		
<b>Total</b>		51,745,738	2.20	2,276,367	0.54	564,187	3.09	3,198,190	0.013	697.2	1.00	51,522		
Exploration (in pit, 0.5% Cu cut-off)	Indicated	44,643,555	1.02	913,000									Co (%)	Thousands of pounds
Exploration (in pit, 0.5% Cu cut-off)	Inferred	92,704,271	0.95	1,768,000									0.017	45,000
Exploration (below pit, 1.5% Cu cut-off)	Inferred	63,713,518	2.89	3,683,000									0.025	32,000
<b>Total</b>		201,061,344	1.58	6,364,000									0.020	77,000

SUN – Massive sulfide – Polymetallic (copper, lead, zinc, gold, silver) Source: SoildusGold Inc. technical report dated May 13, 2022														
Exploration (\$75/tonne cut-off)	Indicated	1,888,257	1.48	55,846	1.11	42,035	4.32	162,962	0.006	12.0	1.75	3,307		
Exploration (\$75/tonne cut-off)	Inferred	9,940,632	1.21	239,643	1.46	290,258	4.18	831,334	0.007	73.0	2.39	23,681		
<b>Total</b>		11,828,889	1.24	295,489	1.42	332,293	4.20	994,296	0.007	85	2.31	26,988		

SMUCKER – Massive sulfide – Polymetallic (copper, lead, zinc, gold, silver) Source: Historical resource from Anaconda Copper Mining Company, Internal Report, 1981; cited in Trilogy Metals news release dated March 19, 2019.														
Exploration	Inferred	12,786,796	0.95	242,949	2.3	588,193	6.4	1,636,710	0.025	324.8	4.78	61,084		

HORSE CREEK – Massive sulfide – Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1985; cited in Trilogy Metals news release dated March 19, 2019.														
Exploration	Historic	11,000,000	1.00	220,000	2	440,000	3	660,000			0.91	9,957		

SUNSHINE – Massive sulfide – Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019.														
Exploration	Historic	22,000,000	1.40	616,000	0.5	220,000	2.5	1,100,000			0.76	16,767		

SHUNGNAC – Massive sulfide – Polymetallic (copper, zinc, silver) Source: Historical resource from Bear Creek Mining Company, Internal Report, 1983; cited in Trilogy Metals news release dated March 19, 2019.														
Exploration	Historic	1,100,000	3.00	66,000			2	44,000			1.82	1,998		

BT – Massive sulfide – Polymetallic (copper, lead, zinc, silver) Source: Historical resource from Kennecott Mines Company, Internal Report, 1997; cited in Trilogy Metals news release dated March 19, 2019.														
Exploration	Historic	3,800,000	1.70	129,200	0.9	68,400	2.6	197,600			1.18	4,483		

CARIBOU DOME – Sediment-hosted – Base metals (copper) Source: High-Grade Initial JORC Resource Estimate -- Caribou Dome; Coventry Resources news release dated April 5, 2017														
Advanced Exploration (0.5% Cu cut-off)	Measured	627,214	3.6	46,297										
Advanced Exploration (0.5% Cu cut-off)	Indicated	653,670	2.2	28,660										
Advanced Exploration (0.5% Cu cut-off)	Inferred	1,801,175	3.2	114,639										
<b>Total</b>		3,082,059	3.1	189,596										
Advanced Exploration (0.3 CuEq cut-off)	Measured	580,912,100	0.33	3,830,000					0.010	5,930	0.050	28,100	0.018	210,000
Advanced Exploration (0.3 CuEq cut-off)	Indicated	6,535,536,700	0.41	53,580,000					0.010	64,810	0.050	316,400	0.025	3,200,000
Advanced Exploration (0.3 CuEq cut-off)	Inferred	4,909,644,200	0.25	24,540,000					0.007	35,800	0.035	170,400	0.023	2,180,000
													Re (ppm)	Thousands of pounds

<b>Total</b>		12,026,093,000	0.341	81,950,000			0.009	106,540	0.044	514,900	0.023	5,590,000	0.39	9,288
<b>PYRAMID – Porphyry – Polymetallic (copper, gold, molybdenum) Source: NI 43-101 Technical Report for the Pyramid Project, Alaska Peninsula, Alaska; report dated January 2018</b>														
Main Zone (0.20% Cu-equivalent cut-off)	Inferred	155,315,479	0.38	1,186,000			0.003	442.0			0.022	68,000		
West Zone (0.20% Cu-equivalent cut-off)	Inferred	13,778,875	0.28	76,000			0.002	14.0			0.010	2,000		
<b>Total</b>		169,094,354	0.37	1,262,000			0.003	456.0			0.021	70,000		
<b>RAINTREE WEST – Porphyry – Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated June 11, 2021</b>														
Exploration (Pit-constrained)	Indicated	8,598,018	0.09	15,000			0.014	100.0	0.143	1,200				
Exploration (Underground)	Indicated	2,976,237	0.13	8,000			0.023	100.0	0.122	400				
Exploration (Pit-constrained)	Inferred	13,007,260	0.07	18,000			0.018	200.0	0.134	1,700				
Exploration (Underground)	Inferred	43,871,940	0.12	107,000			0.023	1,000.0	0.073	3,200				
<b>Total</b>		68,453,455	0.11	148,000			0.021	1,400	0.096	6,500				
<b>ISLAND MOUNTAIN – Porphyry – Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated June 11, 2021</b>														
Exploration (Pit-constrained)	Inferred	123,348,500	0.05	131,000			0.014	1,700.0	0.031	3,800				
<b>Total</b>		123,348,500	0.05	131,000			0.014	1,700.0	0.031	3,800				
<b>WHISTLER – Porphyry – Polymetallic (copper, gold, silver) Source: NI 43-101 Resource Estimate for the Whistler Project; report dated June 11, 2021</b>														
Exploration (Pit-constrained; Whistler)	Indicated	118,829,000	0.17	399,000			0.015	1,800.0	0.057	6,800				
Exploration (Pit-constrained; Whistler)	Inferred	169,204,600	0.13	455,000			0.010	1,700.0	0.043	7,300				
<b>Total</b>		288,033,600	0.15	854,000			0.012	3,500.0	0.049	14,100				
<b>ZACKLY – Skarn – Polymetallic (copper, gold, silver) Source: JORC-compliant resource, PolarX news release (scoping study) dated October 17, 2022</b>														
Exploration	Indicated	2,755,000	1.2	33,831			0.055	155	0.405	1,120				
Exploration	Inferred	1,653,000	0.9	33,831			0.035	58	0.303	513				
<b>Total</b>		4,408,000	1.1	67,663			0.047	213	0.367	1,633				
<b>QUARTZ HILL – Porphyry – (Molybdenum) Source: Mineral investigations in the Ketchikan mining district, southeastern Alaska: U.S. Bureau of Mines Open-File Report 11-95 (1995)</b>														
Exploration	"Probable re-source"	489,425,640									0.131	1,285,182		
Exploration	"Possible re-source"	1,499,141,600									0.082	2,444,643		
<b>Total</b>		1,988,567,240									0.094	3,729,826		
											<b>TREO (%)</b>		<b>Thousands of pounds</b>	
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Indicated	5,278,000									0.602	63,544		
Advanced Exploration (Dotson trend, 0.4% TREO cut-off)	Inferred	1,157,000									0.603	13,959		
<b>Total</b>		6,435,000									0.602	77,503		
											<b>Graphite (%)</b>		<b>Thousands of pounds</b>	
Advanced Exploration (variable 2.0% - 3.0% Cg cut-off)	Proven	4,200,824									6.0	506,920		
Advanced Exploration (variable 2.0% - 3.0% Cg cut-off)	Probable	20,583,156									5.5	2,265,712		
Exploration (2.0% Cg cut-off)	Measured	5,146,340									5.83	599,940		
Exploration (2.0% Cg cut-off)	Indicated	30,712,740									5.15	3,163,038		
Exploration (2.0% Cg cut-off)	Inferred	280,646,340									5.11	28,660,853		
<b>Total</b>		341,289,400									5.16	35,196,463		
											<b>Barite (%)</b>		<b>Thousands of pounds</b>	
USGS geological/geophysical estimate (range 4.5-38.4 million metric tons; mid-range value: 18.4 million metric tons)	Inferred	20,200,000									93	37,600,000		
USGS, USBM geological/geophysical estimate (barite grade unspecified)	Inferred	11,079,331									?	?		

Mining districts <sup>a</sup>	Production (in refined troy ounces)		
	Total	Placer	Lode
1 Lisburne district	0	0	0
2 Noatak district	7,800	7,800	0
3 Wainwright district	0	0	0
4 Barrow district	0	0	0
5 Colville district	0	0	0
6 Canning district	0	0	0
7 Sheenjek district	0	0	0
8 Chandalar district	70,278	52,878	17,400
9 Koyukuk district	378,075	378,075	0
10 Shungnak district	15,000	15,000	0
11 Kiana & Selawik districts	40,607	40,607	0
12 Fairhaven district (Candle subdistrict)	254,265	254,265	0
13 Fairhaven district (Inmachuk subdistrict)	349,975	349,975	0
14 Serpentine district	4,536	4,536	0
15 Port Clarence district	42,358	42,358	0
16 Kougarok district	191,712	191,712	0
17 Nome (Cape Nome) district	5,043,465	5,043,465	0
18 Council district	1,047,042	1,020,042	27,000
19 Koyuk district	84,462	84,462	0
20 Hughes district	403,671	403,671	0
21 Kaiyuh district	149,703	5,400	144,303
22 Anvik district	7	7	0
23 Marshall district	124,506	124,506	0
24 Bethel district	42,953	42,953	0
25 Goodnews Bay district	31,202	31,202	0
26 Aniak district	613,407	613,407	0
27 Iditarod district	1,565,226	1,562,296	2,930
28 McGrath district	364,672	133,307	231,365
29 Innoko district	757,219	757,063	156
30 Ruby district	478,023	478,023	0
31 Kantishna district	99,307	91,401	7,906
32 Hot Springs district	604,926	604,926	0
33 Melozitna district	14,630	14,630	0
34 Rampart district	204,845	204,845	0
35 Tolovana district	547,556	547,556	0
36 Yukon Flats district	0	0	0
37 Circle district	1,125,341	1,125,341	0
38 Black district	2	2	0
39 Eagle district	52,166	52,166	0
40 Fortymile district	602,758	602,758	0
41 Chisana district	144,521	78,021	66,500
42 Tok district	288	288	0
43 Goodpaster district	4,687,905	2,051	4,685,854
44 Fairbanks district	17,418,627	8,282,595	9,136,032

Mining districts <sup>a</sup>	Production (in refined troy ounces)		
	Total	Placer	Lode
45 Bonnifield district	108,983	102,283	6,700
46 Richardson subdistrict of Fairbanks district <sup>b</sup>	121,828	119,528	2,300
47 Delta River district	11,732	11,732	0
48 Chistochina district	186,604	186,604	0
49 Valdez Creek district	533,167	531,586	1,581
50 Yentna district	204,980	204,980	0
51 Redoubt district	105	105	0
52 Bristol Bay Region	1,570	1,570	0
53 Kodiak district (53b)–Alaska Peninsula Region (53a)	112,409	4,809	107,600
54 Homer district	17	17	0
55 Hope & Seward districts	135,252	70,252	65,000
56 Anchorage district <sup>c</sup>	460	460	0
57 Willow Creek district	667,841	58,841	609,000
58 Prince William Sound district	137,802	102	137,700
59 Nelchina district	15,016	15,016	0
60 Nizina district	148,500	148,500	0
61 Yakataga district	18,041	18,041	0
62 Yakutat district <sup>d</sup>	13,200	2,200	11,000
63 Juneau district (partial)	82,540	82,540	0
64 Admiralty (64b) & Juneau (64a) districts	11,099,626	82,390	11,017,236
65 Chichagof district	770,000	0	770,000
66 Petersburg district	15,000	15,000	0
67 Kupreanof district	0	0	0
68 Hyder district	219	219	0
69 Ketchikan district	86,823	4,002	82,821
70 Bering Sea Region	0	0	0
71 Aleutian Islands Region	0	0	0
Unknown (undistributed) <sup>e</sup>	390,035	386,841	3,194
<b>TOTAL (refined Troy ounces)</b>	<b>52,424,785</b>	<b>27,133,578</b>	<b>26,430,245</b>

(1,631 metric tons)

<sup>a</sup>Mining district names and boundaries revised slightly from those defined by Ransome and Kerns (1954) and Cobb (1973). Sources of data: U.S. Geological Survey, U.S. Bureau of Mines, and Alaska Territorial Department of Mines records 1880–1930; U.S. Mint records 1930–1969; State of Alaska production records 1970–2020. Entries of "0" generally mean no specific records are available.

<sup>b</sup>Not included in total for Fairbanks district.

<sup>c</sup>Most placer gold production included in Willow Creek district.

<sup>d</sup>Includes lode production from Glacier Bay area and placer production from Lituya Bay area.

<sup>e</sup>Production that cannot be credited to individual districts due to lack of specific records or for reasons of confidentiality. Beginning in 2015, placer production is not compiled for individual mining districts, but is instead included in the 'Unknown' category.

