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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, DC 20549

Form 10-K

☒ ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2021

or

☐ TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

Commission file number: 1-13105

Arch Resources, Inc.
(Exact name of registrant as specified in its charter)

Delaware	**43-0921172**
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification Number)
1 CityPlace Drive **Suite 300** **St. Louis** **Missouri**	
(Address of principal executive offices)	**63141** (Zip code)

Registrant's telephone number, including area code: **(314) 994-2700**

Securities registered pursuant to Section 12(b) of the Act:

Title of Each Class	**Trading Symbol**	**Name of Each Exchange on Which Registered**
Common Stock, $.01 par value	ARCH	New York Stock Exchange

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant: (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, smaller reporting company, or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☒	Accelerated filer	☐
Non-accelerated filer	☐	Smaller reporting company	☐
		Emerging growth company	☐

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act (15 U.S.C. 7262(b)) by the registered public accounting firm that prepared or issued its audit report. ☒

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Act). Yes☐ No ☒

The aggregate market value of the voting stock held by non-affiliates of the registrant (excluding outstanding shares beneficially owned by directors, officers, other affiliates and treasury shares) as of **June 30, 2021** was approximately $871.4 million.

At January 31, 2022 there were 15,393,053 shares of the registrant's common stock outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's definitive proxy statement to be filed with the Securities and Exchange Commission in connection with the 2022 annual stockholders' meeting are incorporated by reference into Part III of this Form 10-K.

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If you are not familiar with any of the mining terms used in this report, we have provided explanations of many of them under the caption "Glossary of Selected Mining Terms" on page 38 of this report. Unless the context otherwise requires, all references in this report to "Arch," the Company," "we," "us," or "our" are to Arch Resources, Inc. and its subsidiaries.

CAUTIONARY STATEMENTS REGARDING FORWARD-LOOKING INFORMATION

This report contains forward-looking statements, within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, such as our expected future business and financial performance, and are intended to come within the safe harbor protections provided by those sections. The words "anticipates," "believes," "could," "estimates," "expects," "intends," "may," "plans," "predicts," "projects," "seeks," "should," "will" or other comparable words and phrases identify forward-looking statements, which speak only as of the date of this report. Forward-looking statements by their nature address matters that are, to different degrees, uncertain. Actual results may vary significantly from those anticipated due to many factors, including:

- impacts of the COVID-19 pandemic;
- changes in coal prices, which may be caused by numerous factors beyond our control, including changes in the domestic and foreign supply of and demand for coal and the domestic and foreign demand for steel and electricity;
- volatile economic and market conditions;
- operating risks beyond our control, including risks related to mining conditions, mining, processing and plant equipment failures or maintenance problems, weather and natural disasters, the unavailability of raw materials, equipment or other critical supplies, mining accidents, and other inherent risks of coal mining that are beyond our control;
- loss of availability, reliability and cost-effectiveness of transportation facilities and fluctuations in transportation costs;
- inflationary pressures and availability and price of mining and other industrial supplies;
- the effects of foreign and domestic trade policies, actions or disputes on the level of trade among the countries and regions in which we operate, the competitiveness of our exports, or our ability to export;
- competition, both within our industry and with producers of competing energy sources, including the effects from any current or future legislation or regulations designed to support, promote or mandate renewable energy sources;
- alternative steel production technologies that may reduce demand for our coal;
- the loss of key personnel or the failure to attract additional qualified personnel and the availability of skilled employees and other workforce factors;
- our ability to secure new coal supply arrangements or to renew existing coal supply arrangements;
- the loss of, or significant reduction in, purchases by our largest customers;
- disruptions in the supply of coal from third parties;
- risks related to our international growth;
- our relationships with, and other conditions affecting our customers and our ability to collect payments from our customers;

- the availability and cost of surety bonds; including potential collateral requirements;
- additional demands for credit support by third parties and decisions by banks, surety bond providers, or other counterparties to reduce or eliminate their exposure to the coal industry;
- inaccuracies in our estimates of our coal reserves;
- defects in title or the loss of a leasehold interest;
- losses as a result of certain marketing and asset optimization strategies;
- cyber-attacks or other security breaches that disrupt our operations, or that result in the unauthorized release of proprietary, confidential or personally identifiable information;
- our ability to acquire or develop coal reserves in an economically feasible manner;
- our ability to comply with the restrictions imposed by our Term Loan Debt Facility and other financing arrangements;
- our ability to service our outstanding indebtedness and raise funds necessary to repurchase Convertible Notes for cash following a fundamental change or to pay any cash amounts due upon conversion;
- existing and future legislation and regulations affecting both our coal mining operations and our customers' coal usage, governmental policies and taxes, including those aimed at reducing emissions of elements such as mercury, sulfur dioxides, nitrogen oxides, particulate matter or greenhouse gases;
- increased pressure from political and regulatory authorities, along with environmental and climate change activist groups, and lending and investment policies adopted by financial institutions and insurance companies to address concerns about the environmental impacts of coal combustion;
- increased attention to environmental, social or governance matters ("ESG");
- our ability to obtain and renew various permits necessary for our mining operations;
- risks related to regulatory agencies ordering certain of our mines to be temporarily or permanently closed under certain circumstances;
- risks related to extensive environmental regulations that impose significant costs on our mining operations, and could result in litigation or material liabilities;
- the accuracy of our estimates of reclamation and other mine closure obligations;
- the existence of hazardous substances or other environmental contamination on property owned or used by us;
- risks related to tax legislation and our ability to use net operating losses and certain tax credits; and
- other factors, including those discussed in "Legal Proceedings", set forth in Item 3 of this report and "Risk Factors," set forth in Item 1A of this report.

All forward-looking statements in this report, as well as all other written and oral forward-looking statements attributable to us or persons acting on our behalf, are expressly qualified in their entirety by the cautionary statements contained in this section and elsewhere in this report. These factors are not necessarily all of the important factors that could affect us. These risks and uncertainties, as well as other risks of which we are not aware or which we currently do not believe to be material, may cause our actual future results to be materially different than those expressed in our forward-looking statements. These forward-looking statements speak only as of the date on which such statements were

made, and we do not undertake to update our forward-looking statements, whether as a result of new information, future events or otherwise, except as may be required by the federal securities laws.

PART I

ITEM 1. BUSINESS

Introduction

We are one of the world's largest coal producers and a premier producer of metallurgical coal. For the year ended December 31, 2021, we sold approximately 73 million tons of coal, including approximately 0.2 million tons of coal we purchased from third parties. We sell substantially all of our coal to steel mills, power plants and industrial facilities. At December 31, 2021, we operated 7 active mines located in three of the major coal-producing regions of the United States. The locations of our mines and access to export facilities enable us to ship coal worldwide. We incorporate by reference the information about the geographical breakdown of our coal sales for the respective periods covered within this Form 10-K contained in Note 24 to the Consolidated Financial Statements, "Risk Concentrations."

Business Strategy

We are a leading U.S. producer of metallurgical products for the global steel industry, and the leading supplier of premium High-Vol A metallurgical coal globally. We operate four large, modern metallurgical mines that consistently set the industry standard for both mine safety and environmental stewardship. The flagship Leer mine consistently ranks among the lowest cost U.S. metallurgical mines and produces a product quality that is recognized and sought-after worldwide.

In the third quarter of 2021, Arch commenced its highly anticipated second longwall operation at its world-class Leer South mine, where the ramp towards full production is expected to be completed in early 2022. The startup of Leer South is expected to increase our annual High-Vol A output to around 8 million tons per year, and is expected to enhance our already advantageous position on the U.S. cost curve; strengthen our coking coal profit margins across a wide range of market conditions; and solidify our position as the leading supplier of High-Vol A coal globally.

The Leer and Leer South operations are complemented by the Beckley and Mountain Laurel mines, which in aggregate provide us with a full suite of high-quality metallurgical products for sale into the global metallurgical market.

Arch and its subsidiaries also operate thermal mines in the Powder River Basin and Colorado. These mines produce thermal coal for sale into the domestic and international power generation markets as well as industrial applications. Arch intends on completing its strategic transition towards steel and metallurgical markets, while managing the long-term wind-down of its legacy thermal assets in the Powder River Basin and Colorado including considering the needs of the Company's thermal employee base, mining communities, and thermal power customers. The Company remains confident that the thermal mines can and will self-fund their own closure obligations while at the same time providing significant, incremental cash flow that will complement the strong cash-generating capabilities of the Company's core metallurgical franchise.

Arch believes that its long-term success depends upon achieving excellence in mine safety and environmental stewardship; conducting business in an most ethical and transparent manner; investing in its people and the communities in which it operates; and demonstrating strong corporate governance. With its strategic shift towards metallurgical products – which are an essential input in the production of new steel – the Company has realigned its value proposition to reflect the global economy's intensifying focus on de-carbonization. During the year, the Company joined Responsible Steel, the steel industry's first global not-for-profit multi-stakeholder standard and certification initiative. Arch is the first and only U.S. metallurgical coal producer to join the organization to date.

Arch is a demonstrated leader in mine safety, with an average lost-time incident rate of 1.01 which is well below the national average of 2.36 (which represents the national average through the third quarter of 2021). Arch subsidiaries have won nine Sentinels of Safety awards — the nation's highest honor for excellence in mine safety — over the course of the past 10 years.

In the environmental arena, Arch subsidiaries have achieved a near-perfect compliance record from 2017 to 2020, with just one notice of violation issued by state mining regulators in each of the past five years. In 2021, Arch subsidiaries had no violations issued by state mining regulators. In the area of water management, Arch subsidiaries took more than 134,000 water quality measurements from over 600 discharge points without a violation in 2021.

Coal Characteristics

End users generally characterize coal as thermal coal or metallurgical coal. Heat value, sulfur, ash, moisture content, and volatility, in the case of metallurgical coal, are important variables in the marketing and transportation of coal. These characteristics help producers determine the best end use of a particular type of coal. The following is a description of these general coal characteristics:

Heat Value. In general, the carbon content of coal supplies most of its heating value, but other factors also influence the amount of energy it contains per unit of weight. The heat value of coal is commonly measured in Btus. Coal is generally classified into four categories, lignite, subbituminous, bituminous and anthracite, reflecting the progressive response of individual deposits of coal to increasing heat and pressure. Anthracite is coal with the highest carbon content and, therefore, the highest heat value, nearing 15,000 Btus per pound. Bituminous coal, used primarily to generate electricity and to make coke for the steel industry, has a heat value ranging between 10,500 and 15,500 Btus per pound. Subbituminous coal ranges from 8,300 to 13,000 Btus per pound and is generally used for electric power generation. Lignite coal is a geologically young coal which has the lowest carbon content and a heat value ranging between 4,000 and 8,300 Btus per pound.

Sulfur Content. Federal and state environmental regulations, including regulations that limit the amount of sulfur dioxide that may be emitted as a result of combustion, have affected and may continue to affect the demand for certain types of coal. The sulfur content of coal can vary from seam to seam and within a single seam. The chemical composition and concentration of sulfur in coal affects the amount of sulfur dioxide produced in combustion. Coal-fueled power plants can comply with sulfur dioxide emission regulations by burning coal with low sulfur content, blending coals with various sulfur contents, purchasing emission allowances on the open market and/or using sulfur dioxide emission reduction technology.

Ash. Ash is the inorganic material remaining after the combustion of coal. As with sulfur, ash content varies from seam to seam. Ash content is an important characteristic of coal because it impacts boiler performance and electric generating plants must handle and dispose of ash following combustion. The composition of the ash, including the proportion of sodium oxide and fusion temperature, is also an important characteristic of coal, as it helps to determine the suitability of the coal to end users. The absence of ash is also important to the process by which metallurgical coal is transformed into coke for use in steel production.

Moisture. Moisture content of coal varies by the type of coal, the region where it is mined and the location of the coal within a seam. In general, high moisture content decreases the heat value and increases the weight of the coal, thereby making it more expensive to transport. Moisture content in coal, on an as-sold basis, can range from approximately 2% to over 30% of the coal's weight.

Other. Users of metallurgical coal measure certain other characteristics, including fluidity, volatility, and swelling capacity to assess the strength of coke produced from a given coal or the amount of coke that certain types of coal will yield. These characteristics are important elements in determining the value of the metallurgical coal we produce and market.

Industry Overview

Background. Coal is mined globally using various methods of surface and underground recovery. Coal is primarily used for steel production and electric power generation, but it is also used for certain industrial processes such as cement production. Coal is a globally marketed commodity and can be transported to demand centers by ocean-going vessels, barge, rail, truck or conveyor belt.

In 2021, world coal production recovered from the COVID-19 pandemic related supply and demand disruptions experienced in 2020. An expansionary economic environment was supportive of coal fundamentals in 2021. Based on International Energy Agency (IEA) and internal estimates, world coal production increased around 4% in 2021 to approximately 8.0 billion metric tons. In spite of the year-over-year growth, 2021 global coal production is likely to fall short of 2019 levels.

China is the largest producer of coal in the world accounting for around 50% of total production. According to the Chinese National Bureau of Statistics, China produced over 4.0 billion metric tons of coal in 2021. Other major coal producing countries are India, Indonesia, the United States, Australia, and Russia. In 2021, U.S. coal production increased by approximately 8% to 525 million metric tons, after decreasing more than 24% in 2020 to around 486 million metric tons mainly due to lower demand for power generation and subdued exports. U.S. coal production has been roughly halved in the past decade as coal-fired generation demand has continued to decrease. The U.S. is now the fourth largest producer after trailing only China a decade ago.

Steel is produced via two main methods: basic oxygen furnace (BOF) and electric arc furnace (EAF). EAF steelmaking produces steel by using an electrical current to melt scrap steel, while BOF steelmaking relies on coke and iron ore as key inputs to produce pig iron, which is then converted into steel. Metallurgical coal is a key part of the BOF process as it is used to make coke.

Approximately 73% of global steel is produced via the BOF steelmaking process, while in the United States, BOF accounts for around 30% of steel production. The main steel producing countries are China, India, Japan, United States, Russia, South Korea, Turkey, Germany, Brazil, and Ukraine. Arch sells high-quality metallurgical coal products that are essential inputs for BOF steel production worldwide. Our focus is to be a premier low-cost, metallurgical coal supplier to the global steel industry.

As economic activity began to recover throughout 2021, so did steel production. After falling sharply in 2020 due to the economic slowdown resulting from the COVID-19 pandemic, steel production rebounded broadly in 2021. World steel production is expected to have increased more than 4% in 2021, based on preliminary data. Demand and production in Europe, North America, South America, and most of Asia returned the steel sector recovery back to pre-pandemic levels or higher. Chinese steel production was a growth outlier during 2020; however, in 2021 it lagged due to government-imposed production controls. Chinese production decreased around 2.5% in 2021, while rest-of-world production grew more than 10%.

Global trade of metallurgical coal was also affected by the pandemic. We estimate metallurgical coal import-export trade flows improved around 4% in 2021 after decreasing by around 8% in 2020. A restoration of trade volumes back to pre-pandemic levels might not take place until after 2021 due to factors that continue to affect the industry including weather, geological issues, workforce absenteeism, supply chain constraints, and COVID-19. The primary nations that supply seaborne metallurgical coal to the global steel markets are Australia, the United States, Canada, and Russia.

Australia is the largest metallurgical coal exporter and the second largest thermal coal exporter, behind Indonesia. Towards the end of 2020, China implemented a ban on coal imports from Australia. This ban imposed by the key importer of coal on the key exporter of coal rearranged historical global trade patterns in 2021. The ban on the import of Australian coal opened up further the Chinese markets to United States coal suppliers in 2021. It is difficult to predict the duration of the ban.

We rank among the largest metallurgical coal producers in the United States. Based on internal estimates, we produced around 11% of total U.S. metallurgical coal, which was estimated to be close to 65 million tons in 2021. Our metallurgical coal was sold to six North American customers and exported to 24 customers overseas in 15 countries in 2021.

All of our metallurgical coal is produced at operations in West Virginia. Approximately 50% of the metallurgical coal produced in the United States is produced in West Virginia. Carbon content, volatility, fluidity, coke

strength after reaction (CSR), and other chemical and physical properties are among critical characteristics for metallurgical coal.

We produce coal used for electric power generation (thermal) from our mines located in Wyoming and Colorado. The sharp economic rebound of 2021 also benefited thermal coal prices. A sharp increase in natural gas prices and tempered investment in thermal coal mine, a lack of qualified labor availability, and other factors limited the supply response, which resulted in record prices for domestic and international markets.

Much of our coal is sold at the mine where title and risk of loss transfer to the customer as coal is loaded into the railcar or truck. Customers are generally responsible for transportation - typically using third party carriers. There are, however, some agreements where we retain responsibility for the coal during delivery to the customer site or intermediate terminal. Our export coals usually change title and risk of loss as the coal is loaded on a vessel. Normally we contract for transportation services from the mine to the ocean loading port. On occasion, we retain title to the coal to the ocean receiving port.

In 2021, approximately 90% of our coal sales volume was sold as a thermal product with the remaining 10% sold as metallurgical. However, due to the significantly higher value and selling price of our metallurgical coals compared to thermal coals, our metallurgical segment contributed around 52% of our sales revenue in 2021.

We seek to establish long-term relationships with customers through exemplary customer service while operating safe and environmentally responsible mines. The commercial environment in which we operate is very competitive. We compete with domestic and international coal producers, traders or brokers, and non-coal based power producers, as well as with electric arc based steel producers. We compete using price, coal quality, transportation, optionality, customer administration, reputation, and reliability.

We have an experienced and knowledgeable sales and marketing group. This group is dedicated to meeting customer needs, coordinating transportation, and managing risk.

Coal prices are tied to competing fuel sources as well as supply and demand patterns, which are influenced by many uncontrollable factors. For power generation, the price of coal is affected by the relative supply and demand of competitive coal, transportation, availability, weather, competing power generation fuels particularly natural gas, governmental subsidies of alternate energy sources, regulations and economic conditions. For metallurgical coal, the price of coal is affected by the supply and demand of competitive coal, transportation, the price of steel, the price of scrap, demand for steel, transportation rates, strength of the U.S. dollar, regulations, international trade disputes and economic conditions.

U.S. Coal Production. The United States is among the top five largest coal producers in the world. According to the U.S. Energy Information Administration (EIA), there are over 250 billion short tons of recoverable coal reserves in the United States. Current domestic recoverable coal reserves could supply the coal-fired generation fleet for the next 450 years, based on current demand.

The EIA subdivides United States coal production into three major areas: Western Region, Appalachia, and Interior Region. According to the preliminary information from EIA, total U.S. coal production increased by an estimated 45 million short tons in 2021, to around 579 million short tons.

The Western Region includes the Powder River Basin and the Western Bituminous region. According to the EIA, coal produced in the Western Region increased from an estimated 306 million short tons in 2020 to 325 million short tons in 2021. The Powder River Basin is located in northeastern Wyoming and southeastern Montana and is the largest producing region in the United States. Coal from this region is sub-bituminous coal with low sulfur content ranging from 0.2% to 0.9% and heating values ranging from 8,300 to 9,500 BTU/lb. Powder River Basin coal generally has a lower heat content than other regions and is produced from thick seams using surface recovery methods. The Western Bituminous region includes Colorado, Utah and southern Wyoming. Coal from this region typically has low sulfur content ranging from 0.4% to 0.8% and heating values ranging from 10,000 to 12,200 BTU/lb. Western

Bituminous coal has certain quality characteristics, especially its higher heat content and low sulfur, that make this a desirable coal for domestic and international power producers.

Appalachia is divided into north, central and southern regions. According to the EIA, coal produced in the Appalachian region increased from 139 million short tons in 2020 to 158 million short tons in 2021. Appalachian coal is located near the prolific eastern shale-gas producing regions. Central Appalachian thermal coal is disadvantaged for power generation because of the depletion of economically attractive reserves, increasing costs of production, and permitting issues. However, virtually all U.S. metallurgical coal is produced in Appalachia and the relative scarcity and high quality of this coal allows for a pricing premium over thermal coal. Appalachia, while still a major producer of thermal coal, is undergoing a shift towards heavier reliance on metallurgical coal production for both domestic and international use. This is especially the case in Central Appalachia.

Northern Appalachia includes Pennsylvania, Northern West Virginia, Ohio and Maryland. Coal from this region generally has a high heat value ranging from 10,300 to 13,500 BTU/lb and a sulfur content ranging from 0.8% to 4.0%. Central Appalachia includes Southern West Virginia, Virginia, Kentucky and Northern Tennessee. Coal mined from this region generally has a high heat value ranging from 11,400 to 13,200 BTU/lb and low sulfur content ranging from 0.2% to 2.0%. Southern Appalachia primarily covers Alabama and generally has a heat content ranging from 11,300 to 12,300 BTU/lb and a sulfur content ranging from 0.7% to 3.0%. Southern Appalachia mines are primarily focused on metallurgical markets.

The Interior Region includes the Illinois Basin and Gulf Lignite production in Texas and Louisiana, and a small producing area in Kansas, Oklahoma, Missouri and Arkansas. The Illinois Basin is the largest producing region in the Interior and consists of Illinois, Indiana and western Kentucky. According to the EIA, coal produced in the Interior Region increased from 91 million short tons in 2020 to approximately 96 million short tons in 2021. Coal from the Illinois Basin generally has a heat value ranging from 10,100 to 12,600 BTU/lb and has a sulfur content ranging from 1.0% to 4.3%. Despite its high sulfur content, coal from the Illinois Basin can generally be used by electric power generation facilities that have installed emissions control devices, such as scrubbers.

Coal Mining Methods

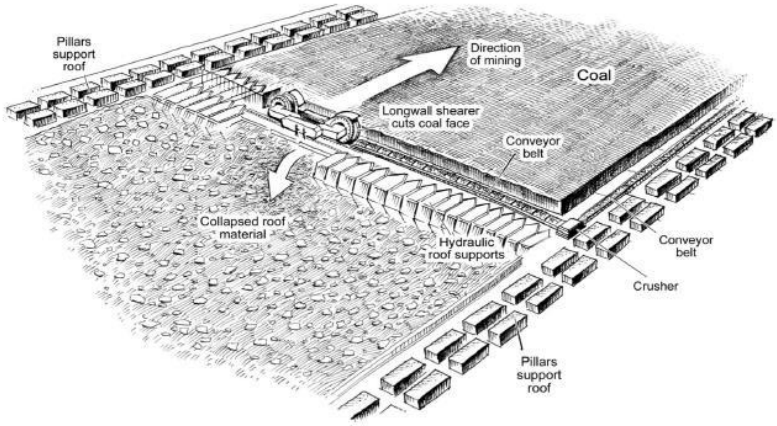
The geological characteristics of our coal reserves largely determine the coal mining method we employ. We use two primary methods of mining coal: underground mining and surface mining.

Underground Mining. We use underground mining methods when coal is located deep beneath the surface. We have included the identity and location of our underground mining operations below under “Our Mining Operations-General.”

Our underground mines are typically operated using one or both of two different mining techniques: longwall mining and room-and-pillar mining.

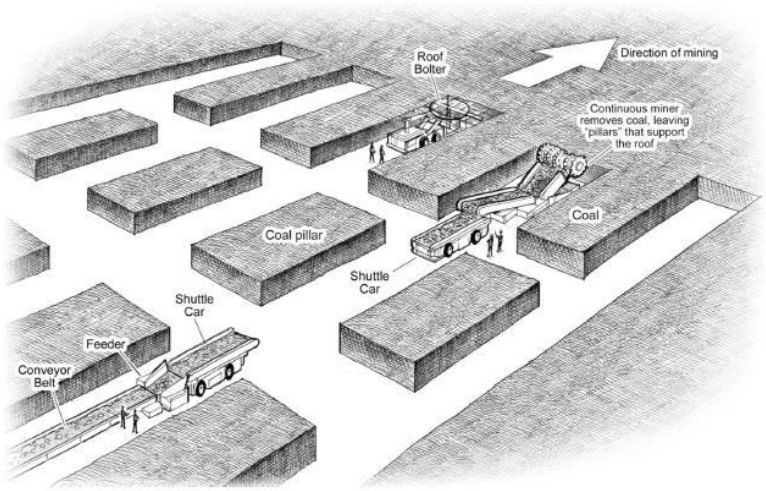
Longwall Mining. Longwall mining involves using a mechanical shearer to extract coal from long rectangular blocks of medium to thick seams. Ultimate seam recovery using longwall mining techniques can exceed 75%. In longwall mining, continuous miners are used to develop access to these long rectangular coal blocks. Hydraulically powered supports temporarily hold up the roof of the mine while a rotating drum mechanically advances across the face of the coal seam, cutting the coal from the face. Chain conveyors then move the loosened coal to an underground mine conveyor system for delivery to the surface. Once coal is extracted from an area, the roof is allowed to collapse in a

controlled fashion. The following diagram illustrates a typical underground mining operation using longwall mining techniques:



Room-and-Pillar Mining. Room-and-pillar mining is effective for small blocks of thin coal seams. In room-and-pillar mining, a network of rooms is cut into the coal seam, leaving a series of pillars of coal to support the roof of the mine. Continuous miners are used to cut the coal and shuttle cars are used to transport the coal to a conveyor belt for further transportation to the surface. The pillars generated as part of this mining method can constitute up to 40% of the total coal in a seam. Higher seam recovery rates can be achieved if retreat mining is used. In retreat mining, coal is mined from the pillars as workers retreat. As retreat mining occurs, the roof is allowed to collapse in a controlled fashion.

The following diagram illustrates our typical underground mining operation using room-and-pillar mining techniques:



Coal Preparation and Blending. We crush the coal mined from our Powder River Basin mining complexes and ship it directly from our mines to the customer. Typically, no additional preparation is required for a saleable product. Coal extracted from some of our underground mining operations contains impurities, such as rock, shale and clay occupying a wide range of particle sizes. All of our mining operations in the Appalachia region use a coal preparation plant located near the mine or connected to the mine by a conveyor. These coal preparation plants allow us to treat the coal we extract from those mines to ensure a consistent quality and to enhance its suitability for particular end-users. In addition, depending on coal quality and customer requirements, we may blend coal mined from different locations, including coal produced by third parties, in order to achieve a more suitable product.

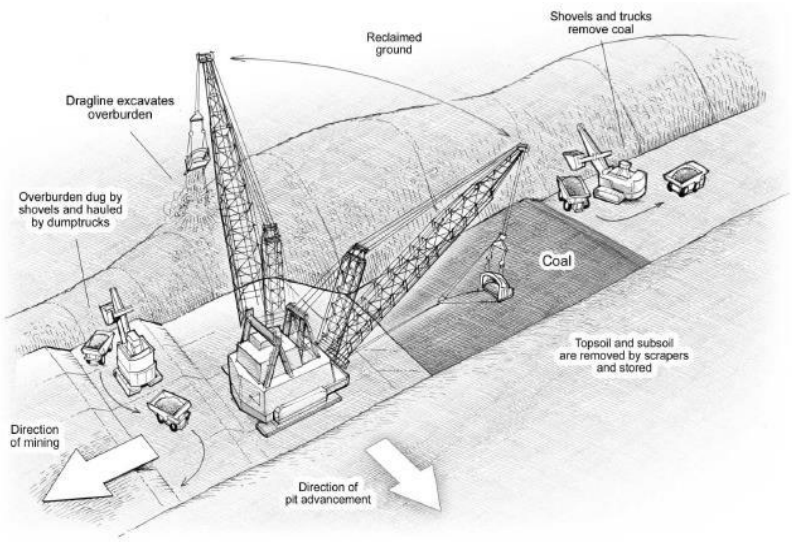
The treatments we employ at our preparation plants depend on the size of the raw coal. For coarse material, the separation process relies on the difference in the density between coal and waste rock and, for the very fine fractions, the separation process relies on the difference in surface chemical properties between coal and the waste minerals. To remove impurities, we crush raw coal and classify it into various sizes. For the largest size fractions, we use dense media vessel separation techniques in which we float coal in a tank containing a liquid of a pre-determined specific gravity. Since coal is lighter than its impurities, it floats, and we can separate it from rock and shale. We treat intermediate sized particles with dense medium cyclones, in which a liquid is spun at high speeds to separate coal from rock. Fine coal is treated in spirals, in which the differences in density between coal and rock allow them, when suspended in water, to be separated. Ultra fine coal is recovered in column flotation cells utilizing the differences in surface chemistry between coal and rock. By injecting stable air bubbles through a suspension of ultra-fine coal and rock, the coal particles adhere to the bubbles and rise to the surface of the column where they are removed. To minimize the moisture content in coal, we process most coal sizes through centrifuges. A centrifuge spins coal very quickly, causing water accompanying the coal to separate.

For more information about the locations of our preparation plants, you should see the section entitled “Our Mining Operations.”

Surface Mining. We use surface mining when coal is found close to the surface. We have included the identity and location of our surface mining operations below under “Our Mining Operations-General.” The majority of the thermal coal we produce comes from surface mining operations.

Surface mining involves removing the topsoil then drilling and blasting the overburden (earth and rock covering the coal) with explosives. We then remove the overburden with heavy earth-moving equipment, such as draglines, power shovels, excavators and loaders. Once exposed, we drill, fracture and systematically remove the coal using haul trucks or conveyors to transport the coal to a preparation plant or to a loadout facility. We reclaim disturbed areas as part of our normal mining activities. After final coal removal, we use draglines, power shovels, excavators or loaders to backfill the remaining pits with the overburden removed at the beginning of the process. Once we have replaced the overburden and topsoil, we reestablish vegetation and plant life into the natural habitat and make other improvements that have local community and environmental benefits.

The following diagram illustrates a typical dragline surface mining operation:



Our Mining Operations

General. At December 31, 2021, we operated 7 active mines in the United States. On December 31, 2020, the Company sold its Viper operation. As a result, the Company revised its reportable segments beginning in the first quarter of 2021 to reflect the manner in which the chief operating decision maker (CODM) views the Company's businesses going forward for purposes of reviewing performance, allocating resources and assessing future prospects and strategic execution. Prior to the first quarter of 2021, the Company had three reportable segments: MET, Powder River Basin (PRB), and Other Thermal. After the divestment of Viper, the Company has three remaining active thermal mines: West Elk, Black Thunder, and Coal Creek. With two distinct lines of business, metallurgical and thermal, the movement to two segments aligns with how the Company makes decisions and allocates resources. No changes were made to the MET Segment and the three remaining thermal mines are now reported as the "Thermal Segment". The prior periods have been recast to reflect the change in reportable segments.

The Company reports its results of operations primarily through the following reportable segments: Metallurgical (MET) segment, containing the Company's metallurgical operations in West Virginia, and the Thermal segment containing the Company's thermal operations in Wyoming and Colorado. For additional information about the operating results of each of our segments for the years ended December 31, 2021, 2020, and 2019, see Note 27 to the Consolidated Financial Statements, "Segment Information."

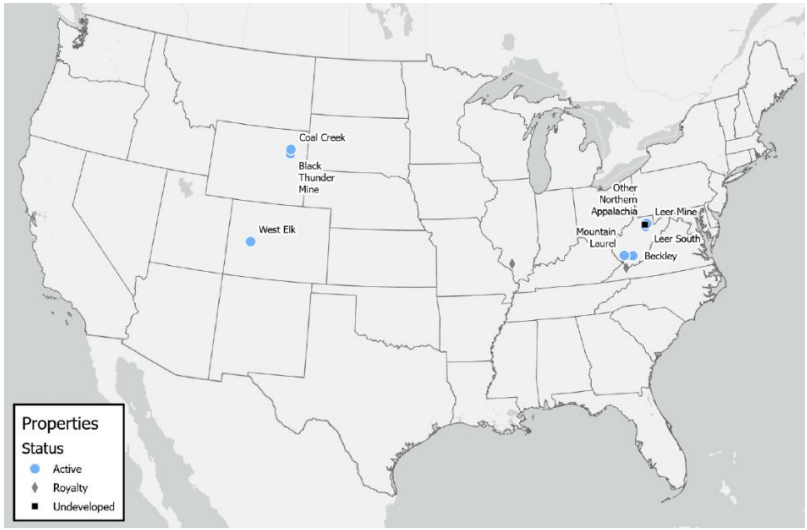
In general, we have developed our mining complexes and preparation plants at strategic locations in close proximity to rail or barge shipping facilities. Coal is transported from our mining complexes to customers by means of railroads, trucks, barge lines, and ocean-going vessels from terminal facilities. We currently own or lease under long-term arrangements all of the equipment utilized in our mining operations. We employ sophisticated preventative maintenance and rebuild programs and upgrade our equipment to ensure that it is productive, well-maintained and cost-competitive.

In November of 2021, we sold our equity investment in Knight Hawk Holdings, LLC, which had been part of our Corporate, Other and Eliminations grouping. For further information on the sale of Knight Hawk Holdings, LLC, please see Note 4 to the Consolidated Financial Statements, "Divestitures."

In December of 2020, we sold our Viper operation, which had been part of our Other Thermal segment, to Knight Hawk Holdings, LLC. For further information on the sale of Viper to Knight Hawk Holdings, LLC, please see Note 4 to the Consolidated Financial Statements, "Divestitures."

In December of 2019, we sold our Coal-Mac operation, Coal-Mac LLC, which had been part of our Other Thermal segment, to Condor Holdings LLC. For further information on the sale of Coal-Mac LLC to Condor Holdings LLC, please see Note 4 to the Consolidated Financial Statements, "Divestitures."

The following map shows the locations of our active, royalty and undeveloped mining operations. Note that this is limited to those properties in which we have current mining operations or expect to have an economic benefit due to mining activity in the future:



The following table provides a summary of information regarding our active mining complexes as of December 31, 2021, including the total tons sold associated with these complexes for the years ended December 31, 2021, 2020, and 2019 and the total reserves associated with these complexes at December 31, 2021. The amount disclosed below for the total cost of property, plant and equipment of each mining complex does not include the costs of the coal reserves that we have assigned to an individual complex. The Company owns 100% of the active mining complexes below.

Mining Complex	Mines	Mining Equipment	Railroad	Tons Sold [1] 2019	2020	2021	Total Cost of Property, Plant and Equipment at December 31, 2021 ($ millions)	Total Recoverable Mineral Reserves (Million tons)
Metallurgical:								
Leer	U	LW, CM	CSX	4.1	4.2	4.6	279.6	44.4
Leer South	U	LW, CM	CSX	1.1	0.7	0.8	621.9	64.5
Beckley	U	CM	CSX	1.0	1.0	1.1	76.3	17.6
Mountain Laurel	U	CM	CSX	1.4	0.9	1.0	55.3	17.8
Thermal:								
Black Thunder	S	D, S	UP/BN	72.0	50.2	60.2	$ 188.7	545.0
Coal Creek	S	D, S	UP/BN	2.6	2.1	2.0	0.3	—
West Elk	U	LW, CM	UP	4.1	2.5	3.0	—	51.9
Totals				86.3	61.6	72.7	$ 189.0	741.2

S = Surface mine
U = Underground mine

D = Dragline
S = Shovel/truck
LW = Longwall
CM = Continuous miner

UP = Union Pacific Railroad
CSX = CSX Transportation
BN = Burlington Northern-Santa Fe Railway

(1) Tons of coal we purchased from third parties that were not processed through our loadout facilities are not included in the amounts shown in the table above.

In October 2018, the Securities and Exchange Commission (“SEC”) adopted amendments to its current disclosure rules to modernize the mineral property disclosure requirements for mining registrants. The amendments include the adoption of S-K 1300, which will govern disclosure for mining registrants (the “SEC Mining Modernization Rules”).

Descriptions in this report of our mineral reserves and resources are prepared in accordance with S-K 1300, as well as similar information provided by other issuers in accordance with S-K 1300, may not be comparable to similar information that is presented elsewhere outside of this report. Please refer to the Technical Report Summaries (“TRS”) filed as Exhibits 96.1-96.3 hereto for additional information with respect to our material properties. Refer to Item 2. Properties for further discussion on the reserves and material properties.

Metallurgical

Leer. The Leer Complex, located in Taylor County, West Virginia, includes approximately 44.4 million tons of coal reserves as of December 31, 2021 and is primarily sold as High-Vol A metallurgical quality coal in the Lower Kittanning seam, and is part of approximately 93,100 acres that is considered our Tygart Valley area. Substantially all of the reserves at Leer are owned rather than leased from third parties.

All the production is processed through a 1,400 ton-per-hour preparation plant and loaded on the CSX railroad. A 15,000-ton train can be loaded in less than four hours.

Leer South. The Leer South mining complex consists of the newly commenced longwall Leer South operation in the Lower Kittanning seam, existing Sentinel underground mine in the Clarion seam, a preparation plant and a loadout facility located on approximately 26,000 acres in Barbour County, West Virginia. Plant and coal handling facilities were upgraded to handle longwall volumes and include a 1,600 ton-per-hour preparation plant located near the mine, as well as a loadout facility served by the CSX railroad and connected to the plant by a 4,000 ton-per-hour conveyor system. The loadout facility is capable of loading a 15,000 ton unit train in less than four hours.

Coal quality is primarily High-Vol A metallurgical coal similar to our Leer Complex. The Leer South mining complex had approximately 64.5 million tons of proven and probable reserves at December 31, 2021. A significant portion of the reserves at Leer South are owned rather than leased from third parties.

Beckley. The Beckley mining complex is located on approximately 19,700 acres in Raleigh County, West Virginia. Beckley is extracting high quality, Low-Vol metallurgical coal in the Pocahontas No. 3 seam. The Beckley mining complex had approximately 17.6 million tons of proven and probable reserves at December 31, 2021.

Coal is conveyed from the mine to a 600-ton-per-hour preparation plant before shipping the coal via the CSX railroad. The loadout facility can load a 10,000-ton train in less than four hours.

Mountain Laurel. Mountain Laurel is an underground mining complex located on approximately 38,200 acres in Logan County and Boone County, West Virginia. Underground mining operations at the Mountain Laurel mining complex extracts High-Vol B metallurgical coal from the Alma and No. 2 Gas seams. Including the No. 2 Gas seam, the Mountain Laurel mining complex has approximately 17.8 million tons of proven and probable reserves at December 31, 2021.

We process all of the coal through a 1,400-ton-per-hour preparation plant before shipping the coal to our customers via the CSX railroad. The loadout facility can load a 15,000-ton train in less than four hours.

Thermal

Black Thunder. Black Thunder is a surface mining complex located on approximately 35,400 acres in Campbell County, Wyoming. The Black Thunder complex extracts thermal coal from the Upper Wyodak and Main Wyodak seams.

We control a significant portion of the coal reserves through federal and state leases. The Black Thunder mining complex had approximately 545 million tons of proven and probable reserves at December 31, 2021.

The Black Thunder mining complex currently consists of four active pit areas and two active loadout facilities. We ship all of the coal raw to our customers via the Burlington Northern Santa Fe and Union Pacific railroads. We do not process the coal mined at this complex. Each of the loadout facilities can load a 15,000-ton train in less than two hours.

Coal Creek. Coal Creek is a surface mining complex located on approximately 7,400 acres in Campbell County, Wyoming. The Coal Creek mining complex extracts thermal coal from the Wyodak-R1 and Wyodak-R3 seams.

In alignment with our desire to shrink our operational footprint and associated liabilities, we have committed to systematically reclaiming our Coal Creek operation in the Powder River Basin as sales from Coal Creek taper down.

The Coal Creek complex currently consists of one active pit area and a loadout facility. We ship all of the coal raw to our customers via the Burlington Northern Santa Fe and Union Pacific railroads. We do not process the coal mined at this complex. The loadout facility can load a 15,000-ton train in less than three hours.

West Elk. West Elk is an underground mining complex located on approximately 18,400 acres in Gunnison County, Colorado. The West Elk mining complex extracts thermal coal from the E seam. We are currently working on developing the B seam at the complex.

We control a significant portion of the coal reserves through federal and state leases. The West Elk mining complex had approximately 51.9 million tons of proven and probable reserves at December 31, 2021.

The West Elk complex currently consists of a longwall, continuous miner sections and a loadout facility. We ship most of the coal raw to our customers via the Union Pacific railroad. The loadout facility can load an 11,000-ton train in less than three hours.

Sales, Marketing and Trading

Overview. Coal prices are influenced by a number of factors and can vary materially by region. The price of coal within a region is influenced by general marketplace conditions, the supply and price of alternative fuels to coal (such as natural gas and subsidized renewables), production costs, coal quality, transportation costs involved in moving coal from the mine to the point of use and mine operating costs. For example, in thermal coal markets, higher heat and lower ash content generally result in higher prices, and higher sulfur and higher ash content generally result in lower prices within a given geographic region. In metallurgical coal markets, chemical properties within the coal and transportation costs determine price differences.

The cost of producing coal at the mine is also influenced by geologic characteristics such as seam thickness, overburden ratios and depth of underground reserves. It is generally less expensive to mine coal seams that are thick and located close to the surface than to mine thin underground seams. Within a particular geographic region, underground mining, which is the mining method we use in certain of our Appalachian mines, is generally more expensive than surface mining, which is the mining method we use in the Powder River Basin. This is the case because of the higher capital costs relative to the reserve base, including costs for construction of extensive ventilation systems, and higher per unit labor costs due to lower productivity associated with underground mining.

Our sales, marketing and trading functions are principally based in St. Louis, Missouri and consist of sales and trading, transportation and distribution, quality control and contract administration personnel as well as revenue management. We also have sales representatives in our Singapore and London offices. In addition to selling coal produced from our mining complexes, from time to time we purchase and sell coal mined by others, some of which we blend with coal produced from our mines. We focus on meeting the needs and specifications of our customers rather than just selling our coal production.

Customers. The Company markets its metallurgical and thermal coal to domestic and foreign steel producers, domestic and foreign power generators, and other industrial facilities. For the year ended December 31, 2021, we derived approximately 20% of our total coal revenues from sales to our three largest customers, ArcelorMittal, ThyssenKrupp AG and Union Electric dba Ameren Missouri and approximately 49% of our total coal revenues from sales to our 10 largest customers.

In 2021, we sold coal to domestic customers located in 27 different states. The locations of our mines enable us to ship coal to most of the major coal-fueled power plants in the United States.

In addition, in 2021 we exported coal to Europe, Asia, Central and South America. Exports to seaborne countries were $1.1 billion, $0.5 billion and $1.0 billion for the years ended December 31, 2021, 2020 and 2019, respectively. As of December 31, 2021 and 2020, trade receivables related to metallurgical-quality coal sales totaled $251.5 million and $69.1 million, respectively, or 78% and 62% of total trade receivables, respectively. We do not have foreign currency exposure for our international sales as all sales are denominated and settled in U.S. dollars.

The Company's seaborne revenues by coal shipment destination for the year ended December 31, 2021, were as follows:

(In thousands)		
Europe	$	592,702
Asia		446,724
Central and South America		109,613
Total	$	1,149,039

Long-Term Coal Supply Arrangements

As is customary in the coal industry, we enter into fixed price, fixed volume term-based supply contracts, the terms of which are sometimes more than one year ("Long-Term"), with many of our customers. Multiple year contracts usually have specific and possibly different volume and pricing arrangements for each year of the contract. Long-term contracts allow customers to secure a supply for their future needs and provide us with greater predictability of sales volume and sales prices. In 2021, we sold approximately 63% of the tonnage (representing approximately 35% of the Company's revenues) of our coal under long-term supply arrangements. The majority of our supply contracts include a fixed price for the term of the agreement or a pre-determined escalation in price for each year. Some of our long-term supply agreements may include a variable pricing system. While most of our sales contracts are for terms of one to five years, some are as short as one month. At December 31, 2021, the average volume-weighted remaining term of our long-term contracts for metallurgical and thermal coal was approximately 2.5 years, with remaining terms ranging from one to five years. At December 31, 2021, remaining tons under long-term supply agreements, including those subject to price re-opener or extension provisions, were approximately 127.8 million tons.

We typically sell coal to North American customers under term arrangements through a "request-for-proposal" process. We also respond to private solicitations and generally do not know if a customer intends to buy the coal for which they solicited. The terms of our coal sales agreements are dictated by the availability and price of alternative fuels, general marketplace conditions, the quality of the coal we have available to sell, our mine operations (including operating costs), the length of contract, as well as negotiations with customers. Consequently, the terms of these contracts may vary to some extent by customer, including base price adjustment features, price re-opener terms, coal quality requirements, quantity parameters, permitted sources of supply, future regulatory changes, extension options, *force majeure*, termination, damages and assignment provisions. Our long-term supply contracts typically contain provisions to adjust the base price due to new statutes, ordinances or regulations. We typically sell our metallurgical coal to non-North American customers based on various indices or agreements to mutually negotiate the price. These agreements generally are for one year and can reset pricing with each shipment. Additionally, some of our contracts contain provisions that allow for the recovery of costs affected by modifications or changes in the interpretations or application of any applicable statute by local, state or federal government authorities. These provisions only apply to the base price of coal contained in these supply contracts. In some circumstances, a significant adjustment in base price can lead to termination of the contract.

Certain of our contracts contain index provisions that change the price based on changes in market based indices or changes in economic indices or both. Certain of our contracts contain price re-opener provisions that may allow a party to commence a renegotiation of the contract price at a pre-determined time. Price re-opener provisions may automatically set a new price based on prevailing market price or, in some instances, require us to negotiate a new price, sometimes within a specified range of prices. In a limited number of agreements, if the parties do not agree on a new price, either party has an option to suspend the agreement for the pricing period not agreed to. In addition, certain of our contracts contain clauses that may allow customers to terminate the contract in the event of certain changes in environmental laws and regulations that impact their operations.

Customers are generally required to take their coal on a ratable basis but have been known to push sales out in low demand periods when contract prices are higher. Each of these situations must be dealt with on an individual basis.

Coal quality and volumes are stipulated in coal sales agreements. In most cases, the annual pricing and volume obligations are fixed, although in some cases the volume specified may vary depending on the customer consumption

requirements. Most of our coal sales agreements contain provisions requiring us to deliver coal within certain ranges for specific coal characteristics such as heat content (for thermal coal contracts), volatile matter (for metallurgical coal contracts), and for both types of contracts, sulfur, ash and moisture content. Failure to meet these specifications can result in economic penalties, suspension or cancellation of shipments or termination of the contracts.

Our coal sales agreements also typically contain *force majeure* provisions allowing temporary suspension of performance by us or our customers, during the duration of events beyond the control of the affected party, including events such as strikes, adverse mining conditions, mine closures or serious transportation problems that affect us or unanticipated plant outages that may affect the buyer. Our contracts also generally provide that in the event a *force majeure* circumstance exceeds a certain time period, the unaffected party may have the option to terminate the purchase or sale in whole or in part. Some contracts stipulate that this tonnage can be made up by mutual agreement or at the discretion of the buyer. Agreements between our customers and the railroads servicing our mines may also contain *force majeure* provisions.

In most of our thermal coal contracts, we have a right of substitution (unilateral or subject to counterparty approval), allowing us to provide coal from different mines, including third-party mines, as long as the replacement coal meets quality specifications and will be sold at the same equivalent delivered cost.

In some of our coal supply contracts, we agree to indemnify or reimburse our customers for damage to their or their rail carrier's equipment while on our property, which results from our or our agents' negligence, and for damage to our customer's equipment due to non-coal materials being included with our coal while on our property.

Trading. In addition to marketing and selling coal to customers through traditional coal supply arrangements, we seek to optimize our coal production and leverage our knowledge of the coal industry through a variety of other marketing, trading and asset optimization strategies. From time to time, we may employ strategies to use coal and coal-related commodities and contracts for those commodities in order to manage and hedge volumes and/or prices associated with our coal sales or purchase commitments, reduce our exposure to the volatility of market prices or augment the value of our portfolio of traditional assets. These strategies may include physical coal contracts, as well as a variety of forward, futures or options contracts, swap agreements or other financial instruments, in coal or other commodities such as natural gas and foreign currencies.

We maintain a system of complementary processes and controls designed to monitor and manage our exposure to market and other risks that may arise as a consequence of these strategies. These processes and controls seek to preserve our ability to profit from certain marketing, trading and asset optimization strategies while mitigating our exposure to potential losses.

Transportation. We generally sell coal to international customers at export terminals, and we are usually responsible for the cost of transporting coal to the export terminals. We transport our coal to Atlantic coast terminals, Pacific cost terminals or terminals along the Gulf of Mexico for transportation to international customers. Our international customers are generally responsible for paying the cost of ocean freight. We may also sell coal to international customers delivered to an unloading facility at the destination country.

We own a 35% interest in Dominion Terminal Associates LLP, a limited liability partnership that operates a ground storage-to-vessel coal transloading facility in Newport News, Virginia. The facility has a rated throughput capacity of 20 million tons of coal per year and ground storage capacity of approximately 1.7 million tons. The facility primarily serves international customers, as well as domestic coal users located along the Atlantic coast of the United States. From time-to-time, we may lease a portion of our port capacity to third parties.

We ship our coal to domestic customers by means of railcars, barges, or trucks, or a combination of these means of transportation. We generally sell coal used for domestic consumption free on board (f.o.b.) at the mine or nearest loading facility. Our domestic customers normally bear the costs of transporting coal by rail, barge or truck.

Historically, most domestic electricity generators have arranged long-term shipping contracts with rail, trucking or barge companies to assure stable delivery costs. Transportation can be a large component of a purchaser's total cost.

Although the purchaser pays the freight, transportation costs still are important to coal mining companies because the purchaser may choose a supplier largely based on cost of transportation. Transportation costs borne by the customer vary greatly based on each customer's proximity to the mine and our proximity to the loadout facilities. Trucks and overland conveyors haul coal over shorter distances, while barges, Great Lake carriers and ocean vessels move coal to export markets and domestic markets requiring shipment over the Great Lakes and several river systems.

Most coal mines are served by a single rail company, but much of the Powder River Basin is served by two rail carriers: the Burlington Northern-Santa Fe railroad and the Union Pacific railroad. We generally transport coal produced at our Appalachian mining complexes via the CSX railroad. Besides rail deliveries, some customers in the eastern United States rely on a river barge system.

Competition

The coal industry is intensely competitive with alternative energy sources outside of the industry and between producing companies. The most important factors on which we compete are coal quality, delivered costs to the customer and reliability of supply. Our principal domestic coal-producing competitors include Alpha Metallurgical Resources Inc.; Coronado Coal LLC; Corsa Coal Corp.; Eagle Specialty Materials LLC; Navajo Transitional Energy Company LLC; Peabody Energy Corp.; Ramaco Resources; and Warrior Met Coal, Inc. Some of these coal producers are larger than we are and have greater financial resources and larger reserve bases than we do. We also compete directly with a number of smaller producers in each of the geographic regions in which we operate, as well as companies that produce coal from one or more foreign countries, such as Australia, Canada, Colombia, Indonesia and South Africa.

Our principal competitor in thermal coal is natural gas, other alternative fuels, and subsidized renewables. Specifically, coal competes directly with other fuels, such as natural gas, nuclear energy, hydropower, subsidized renewable, and petroleum, for steam and electrical power generation. Costs and other factors relating to these alternative fuels, such as safety and environmental considerations, as well as tax incentives and various mandates, affect the overall demand for coal as a fuel and the price we can charge for the coal.

Suppliers

Principal supplies used in our business include petroleum-based fuels, explosives, tires, steel and other raw materials as well as spare parts and other consumables used in the mining process. We use third-party suppliers for a significant portion of our equipment rebuilds and repairs, drilling services and construction. We use sole source suppliers for certain parts of our business such as explosives and fuel, and preferred suppliers for other parts of our business such as original equipment suppliers, dragline and shovel parts and related services. We believe adequate substitute suppliers are available. For more information about our suppliers, you should see Item 1A, "Risk Factors-Increases in the costs of mining and other industrial supplies, including steel-based supplies, diesel fuel and rubber tires, or the inability to obtain a sufficient quantity of those supplies, could negatively affect our operating costs or disrupt or delay our production."

Environmental and Other Regulatory Matters

Federal, state and local authorities regulate the U.S. coal mining industry with respect to matters such as employee health and safety and the environment, including the protection of air quality, water quality, wetlands, special status species of plants and animals, land uses, cultural and historic properties and other environmental resources identified during the permitting process. Reclamation is required during production and after mining has been completed. Materials used and generated by mining operations must also be managed according to applicable regulations and law. These laws have, and will continue to have, a significant effect on our production costs and our competitive position.

We endeavor to conduct our mining operations in compliance with applicable federal, state and local laws and regulations. However, due in part to the extensive, comprehensive and changing regulatory requirements, violations during mining operations occur from time to time. We cannot assure you that we have been or will be at all times in complete compliance with such laws and regulations. Expenditures we incur to maintain compliance with all applicable federal and state laws have been and are expected to continue to be significant. Federal and state mining laws and

regulations require us to obtain surety bonds to guarantee performance or payment of certain long-term obligations, including mine closure and reclamation costs, federal and state workers' compensation benefits, coal leases and other miscellaneous obligations. Compliance with these laws has substantially increased the cost of coal mining for domestic coal producers.

Future laws, regulations or orders, as well as future interpretations and more rigorous enforcement of existing laws, regulations or orders, may require substantial increases in equipment and operating costs and delays, interruptions or a termination of operations, the extent to which we cannot predict. Future laws, regulations or orders may also cause coal to become a less attractive fuel source, thereby reducing coal's share of the market for fuels and other energy sources used to generate electricity. As a result, future laws, regulations or orders may adversely affect our mining operations, cost structure or our customers' demand for coal.

The following is a summary of the various federal and state environmental and similar regulations that have a material impact on our business:

Mining Permits and Approvals. Numerous governmental permits or approvals are required for mining operations. When we apply for these permits and approvals, we may be required to prepare and present to federal, state or local authorities' data pertaining to the effect or impact that any proposed production or processing of coal may have upon the environment. For example, in order to obtain a federal coal lease, an environmental impact statement must be prepared to assist the BLM in determining the potential environmental impact of lease issuance, including any collateral effects from the mining, transportation and burning of coal, which may in some cases include a review of impacts on climate change. The authorization, permitting and implementation requirements imposed by federal, state and local authorities may be costly and time consuming and may delay commencement or continuation of mining operations. In the states where we operate, the applicable laws and regulations also provide that a mining permit or modification can be delayed, refused or revoked if officers, directors, shareholders with specified interests or certain other affiliated entities with specified interests in the applicant or permittee have, or are affiliated with another entity that has, outstanding permit violations. Thus, past or ongoing violations of applicable laws and regulations could provide a basis to revoke existing permits and to deny the issuance of additional permits.

In order to obtain mining permits and approvals from federal and state regulatory authorities, mine operators must submit a reclamation plan for restoring, upon the completion of mining operations, the mined property to its prior condition or other authorized use. Typically, we submit the necessary permit applications several months or even years before we plan to begin mining a new area. Some of our required permits are becoming increasingly more difficult and expensive to obtain, and the application review processes are taking longer to complete and becoming increasingly subject to challenge, and political manipulation even after a permit has been issued.

Under some circumstances, substantial fines and penalties, including revocation or suspension of mining permits, may be imposed under the laws described above. Monetary sanctions and, in severe circumstances, criminal sanctions may be imposed for failure to comply with these laws.

Surface Mining Control and Reclamation Act. The Surface Mining Control and Reclamation Act, which we refer to as SMCRA, establishes mining, environmental protection, reclamation and closure standards for all aspects of surface mining as well as many aspects of underground mining. Mining operators must obtain SMCRA permits and permit renewals from the Office of Surface Mining, which we refer to as OSM, or from the applicable state agency if the state agency has obtained regulatory primacy. A state agency may achieve primacy if the state regulatory agency develops a mining regulatory program that is no less stringent than the federal mining regulatory program under SMCRA. All states in which we conduct mining operations have achieved primacy and issue permits in lieu of OSM.

SMCRA permit provisions include a complex set of requirements which include, among other things, coal prospecting; mine plan development; topsoil or growth medium removal and replacement; selective handling of overburden materials; mine pit backfilling and grading; disposal of excess spoil; protection of the hydrologic balance; subsidence control for underground mines; surface runoff and drainage control; establishment of suitable post mining land uses; and revegetation. We begin the process of preparing a mining permit application by collecting baseline data to adequately characterize the pre-mining environmental conditions of the permit area. This work is typically conducted by

third-party consultants with specialized expertise and includes surveys and/or assessments of the following: cultural and historical resources; geology; soils; vegetation; aquatic organisms; wildlife; potential for threatened, endangered or other special status species; surface and ground water hydrology; climatology; riverine and riparian habitat; and wetlands. The geologic data and information derived from the other surveys and/or assessments are used to develop the mining and reclamation plans presented in the permit application. The mining and reclamation plans address the provisions and performance standards of the state's equivalent SMCRA regulatory program, and are also used to support applications for other authorizations and/or permits required to conduct coal mining activities. Also included in the permit application is information used for documenting surface and mineral ownership, variance requests, access roads, bonding information, mining methods, mining phases, other agreements that may relate to coal, other minerals, oil and gas rights, water rights, permitted areas, and ownership and control information required to determine compliance with OSM's Applicant Violator System, including the mining and compliance history of officers, directors and principal owners of the entity.

Once a permit application is prepared and submitted to the regulatory agency, it goes through an administrative completeness review and a thorough technical review. Also, before a SMCRA permit is issued, a mine operator must submit a bond or otherwise secure the performance of all reclamation obligations. After the application is submitted, a public notice or advertisement of the proposed permit is required to be given, which begins a notice period that is followed by a public comment period before a permit can be issued. It is not uncommon for a SMCRA mine permit application to take over a year to prepare, depending on the size and complexity of the mine, and anywhere from six months to two years or even longer for the permit to be issued. The variability in time frame required to prepare the application and issue the permit can be attributed primarily to the various regulatory authorities' discretion in the handling of comments and objections relating to the project received from the general public and other agencies. Also, it is not uncommon for a permit to be delayed as a result of litigation related to the specific permit or another related company's permit.

In addition to the bond requirement for an active or proposed permit, the Abandoned Mine Land Fund, which was created by SMCRA, requires that a fee be paid on all coal produced. The proceeds of the fee are used to restore mines closed or abandoned prior to SMCRA's adoption in 1977, as well as fund other state and federal initiatives. For the first three quarters of 2021, the fee was $0.28 per ton of coal produced from surface mines and $0.12 per ton of coal produced from underground mines. As a result of the Infrastructure Investment and Jobs Act of 2021, which included the Abandoned Mine Land Reclamation Amendments of 2021, the fees decreased as of the calendar quarter beginning October 1, 2021. The current fee is $0.224 per ton of coal produced from surface mines and $0.096 per ton of coal produced from underground mines. In 2021, we recorded $17.5 million of expense related to these reclamation fees.

Surety Bonds. Mine operators are often required by federal and/or state laws, including SMCRA, to assure, usually through the use of surety bonds, payment of certain long-term obligations including mine closure or reclamation costs, federal and state workers' compensation costs, coal leases and other miscellaneous obligations. Although surety bonds are usually non-cancelable during their term, many of these bonds are renewable on an annual basis and collateral requirements may change.

The costs of these bonds have widely fluctuated in recent years while the market terms of surety bonds have remained difficult for mine operators. These changes in the terms of the bonds have been accompanied at times by a decrease in the number of companies willing to issue surety bonds. As of December 31, 2021, we posted an aggregate of approximately $541.1 million in surety bonds, cash, and letters of credit outstanding for reclamation purposes.

At December 31, 2021, the Company established a fund for asset retirement obligations and thus far has contributed $20 million that will serve to defease the long-term asset retirement obligation for its thermal asset base. During 2022, the Company plans to make contributions to the thermal ARO fund on a quarterly basis and expect total contributions could be at least $100.0 million if market conditions remain favorable.

For additional information, please see "Failure to obtain or renew surety bonds on acceptable terms could affect our ability to secure reclamation and coal lease obligations and, therefore, our ability to mine or lease coal, which could have a material adverse effect on our business and results of operations," contained in Item 1A, "Risk Factors—Risk Related to Our Operations," for a discussion of certain risks associated with our surety bonds.

Mine Safety and Health. Stringent safety and health standards have been imposed by federal legislation since Congress adopted the Mine Safety and Health Act of 1969. The Mine Safety and Health Act of 1977 significantly expanded the enforcement of safety and health standards and imposed comprehensive safety and health standards on all aspects of mining operations. In addition to federal regulatory programs, all of the states in which we operate also have programs aimed at improving mine safety and health. Collectively, federal and state safety and health regulation in the coal mining industry is among the most comprehensive and pervasive systems for the protection of employee health and safety affecting any segment of U.S. industry.

Under the Black Lung Benefits Revenue Act of 1977 and the Black Lung Benefits Reform Act of 1977, each coal mine operator must secure payment of federal black lung benefits to claimants who are current and former employees and to a trust fund for the payment of benefits and medical expenses to claimants who last worked in the coal industry prior to July 1, 1973. The trust fund is funded by an excise tax on coal production. In 2021, the tax was $1.10 per ton for coal mined in underground operations and $0.55 per ton for coal mined in surface operations, in each case not to exceed 4.4% of the gross sales price. The current tax is $.50 per ton for coal mined in underground operations and $0.25 per ton for coal mined in surface operations in each case not to exceed 2.0% of the gross sales price. This excise tax does not apply to coal shipped outside the United States. In 2021, we recorded $34.8 million of expense related to this excise tax. There are currently several bills being considered in Congress which propose to raise this tax, including the Build Back Better Act.

Clean Air Act. The federal Clean Air Act and similar state and local laws that regulate air emissions affect coal mining directly and indirectly. Direct impacts on coal mining and processing operations include Clean Air Act permitting requirements and emissions control requirements. These include emissions of ozone precursors and particulate matter which may include controlling fugitive dust. The Clean Air Act also indirectly affects coal mining operations, for example, by extensively regulating the emissions of fine particulate matter measuring 2.5 micrometers in diameter or smaller, sulfur dioxide, nitrogen oxides, mercury and other compounds emitted by coal-fueled power plants and industrial boilers, which are the largest end-users of our coal. Already stringent regulation of emissions further tightened throughout the Obama Administration, such as the Mercury and Air Toxics Standard (MATS), finalized in 2011 and discussed in more detail below. In addition, the U.S. Environmental Protection Agency, which we refer to as the EPA, has issued regulations with respect to other emissions, such as greenhouse gases (GHGs), from new, modified, reconstructed and existing electric generating units, including coal-fired plants. Other GHG regulations apply to industrial boilers (see discussion of Climate Change, below). On January 20, 2021, the current administration issued an executive order directing all federal agencies to review and take action to address any federal regulations, orders, guidance documents, policies and any similar agency actions promulgated during the prior administration that may be inconsistent with the administration's policies. As a result, it is unclear the degree to which certain recent regulatory developments may be modified or rescinded. The executive order also established an Interagency Working Group on the Social Cost of Greenhouse Gases ("Working Group"), which is called on to, among other things, develop methodologies for calculating the "social cost of carbon," "social cost of nitrous oxide" and "social cost of methane." The Working Group published a Technical Support Document in February 2021 seeking public comments by May 2021. Recommendations from the Working Group were due beginning June 1, 2021 and final recommendations no later than January 2022. The Working Group made initial recommendations in February 2021; final recommendations have not been released. Further regulation of air emissions, as well as uncertainty regarding the future course of regulation, could eventually reduce the demand for coal.

On January 27, 2021, the current administration issued an executive order focused on addressing climate change. Among other things, the executive order directed the Secretary of the Interior to pause new oil and natural gas leasing on public lands or in offshore waters pending completion of a comprehensive review of the federal permitting and leasing practices, consider whether to adjust royalties associated with coal, oil, and gas resources extracted from public lands and offshore waters, or take other appropriate action, to account for corresponding climate costs. In response to the executive order, the U.S. Department of the Interior suspended new oil and gas leases on federal land and in federal waters. The suspension was challenged in federal court, and in June 2021 a federal district court judge in Louisiana issued a preliminary injunction blocking the suspension. The executive order also directed the federal government to identify "fossil fuel subsidies" to take steps to ensure that, to the extent consistent with applicable law, federal funding is not directly subsidizing fossil fuels. In November 2021, the U.S. Department of the Interior issued a "Report On The Federal Oil And Gas Leasing Program," which assesses the current state of oil and gas leasing on

federal lands and proposes several reforms, including raising royalty rates and implementing stricter standards for entities seeking to purchase oil and gas leases.

Clean Air Act requirements that may directly or indirectly affect our operations include the following:

- *Acid Rain.* Title IV of the Clean Air Act, promulgated in 1990, imposed a two-phase reduction of sulfur dioxide emissions by electric utilities. Phase II became effective in 2000 and applies to all coal-fueled power plants with a capacity of more than 25-megawatts. Generally, the affected power plants have sought to comply with these requirements by switching to lower sulfur fuels, installing pollution control devices, reducing electricity generating levels or purchasing or trading sulfur dioxide emissions allowances. Although we cannot accurately predict the future effect of this Clean Air Act provision on our operations, we believe that implementation of Phase II has been factored into the pricing of the coal market.

- *Particulate Matter.* The Clean Air Act requires the EPA to set national ambient air quality standards, which we refer to as NAAQS, for certain pollutants associated with the combustion of coal, including sulfur dioxide, particulate matter, nitrogen oxides and ozone. Areas that are not in compliance with these standards, referred to as non-attainment areas, must take steps to reduce emissions levels. For example, NAAQS currently exist for particulate matter measuring 10 micrometers in diameter or smaller (PM10) and for fine particulate matter measuring 2.5 micrometers in diameter or smaller (PM2.5), and the EPA revised the PM2.5 NAAQS on December 14, 2012, making it more stringent. The states were required to make recommendations on nonattainment designations for the new NAAQS in late 2013. The EPA issued final designations for most areas of the country in 2012 and made some revisions in 2015. Individual states must now identify the sources of emissions and develop emission reduction plans. These plans may be state-specific or regional in scope. Under the Clean Air Act, individual states have up to 12 years from the date of designation to secure emissions reductions from sources contributing to the problem. Future regulation and enforcement of the new PM2.5 standard, as well as future revisions of PM standards, will affect many power plants, especially coal-fueled power plants, and all plants in non-attainment areas.

- *Ozone.* On October 26, 2015, the EPA published a final rule revising the existing primary and secondary NAAQS for ozone, reducing them to 70ppb on an 8-hour average. On November 17, 2016, the EPA issued a proposed implementation rule on non-attainment area classification and state implementation plans (SIPs). The EPA published a final rule in November 2017 that issued area designations with respect to ground-level ozone for approximately 35% of the U.S. counties, designating them as either “attainment/unclassifiable” or “unclassifiable.” In April 2018 and July 2018, the EPA issued ozone designations for all areas not addressed in the November 2017 rule. States with moderate or high nonattainment areas were required to submit SIPs by October 2021. Significant additional emission control expenditures will likely be required at certain coal-fueled power plants to meet the new stricter NAAQS. Nitrogen oxides, which are a byproduct of coal combustion, are classified as an ozone precursor. As a result, emissions control requirements for new and expanded coal-fueled power plants and industrial boilers will continue to become more demanding in the years ahead. On December 6, 2018, the EPA issued a Final Rule implementing the 2015 Ozone NAAQS for nonattainment areas (“2015 Ozone Implementation Rule”). The 2015 Ozone Implementation Rule is notable for providing greater flexibility to States to consider international sources of pollution and other mechanisms for relief from strict application of the standard. With such flexibility, the effect on demand for coal will vary by state. By law, the EPA must review each NAAQS every five years. In December 2020, the EPA announced that it was retaining without revision the 2015 NAAQS for ozone. However, as noted above, on January 20, 2021, the current administration issued an executive order directing federal agencies to review and take action to address any federal regulations or similar agency actions promulgated during the prior administration that may be inconsistent with the current administration’s stated priorities. The EPA was specifically ordered to, among other things, propose a Federal Implementation Plan for ozone standards for California, Connecticut, New York, Pennsylvania and Texas by January 2022. In December 2021 and January 2022, EPA approved multiple revisions to ozone SIPs in Pennsylvania, New York, Connecticut, and a number of air quality districts in California; proceedings are ongoing in Texas and other districts in California.

- *NOx SIP Call*. The Nitrogen Oxides State Implementation Plan (NOx SIP) Call program was established by the EPA in October 1998 to reduce the transport of ozone on prevailing winds from the Midwest and South to states in the Northeast, which said that they could not meet federal air quality standards because of migrating pollution. The program was designed to reduce nitrous oxide emissions by one million tons per year in 22 eastern states and the District of Columbia. Phase II reductions were required by May 2007. As a result of the program, many power plants were required to install additional emission control measures, such as selective catalytic reduction devices. Installation of additional emission control measures has made it more costly to operate coal-fueled power plants, which could make coal a less attractive fuel.

- *Interstate Transport.* The EPA finalized the Clean Air Interstate Rule, which we refer to as CAIR, in March 2005. CAIR called for power plants in 28 Eastern states and the District of Columbia to reduce emission levels of sulfur dioxide and nitrous oxide, which could lead to non-attainment of PM2.5 and ozone NAAQS in downwind states (interstate transport), pursuant to a cap and trade program similar to the system now in effect for acid deposition control. In July 2008, in *State of North Carolina v. EPA* and consolidated cases, the D.C. Circuit disagreed with the EPA's reading of the Clean Air Act and vacated CAIR in its entirety. In December 2008, the D.C. Circuit revised its remedy and remanded the rule to the EPA. The EPA proposed a revised transport rule on August 2, 2010 (75 Fed. Reg. 45209) to address attainment of the 1997 ozone NAAQS and the 2006 PM2.5 NAAQS. The rule was finalized as the Cross State Air Pollution Rule (CSAPR) on July 6, 2011, with compliance required for SO2 reductions beginning January 1, 2012 and compliance with NOx reductions required by May 1, 2012. Numerous appeals of the rule were filed and, on August 21, 2012, the D.C. Circuit vacated the rule, leaving the EPA to continue implementation of the CAIR. Controls required under the CAIR, especially in conjunction with other rules, may have affected the market for coal inasmuch as multiple existing coal fired units were being retired rather than having required controls installed.

  The U.S. Supreme Court agreed to hear the EPA's appeal of the decision vacating CSAPR and on April 29, 2014, issued an opinion reversing the August 21, 2012 D.C. Circuit decision, remanding the case back to the D.C. Circuit. The EPA then requested that the court lift the CSAPR stay and toll the CSAPR compliance deadlines by three years. On October 23, 2014, the D.C. Circuit granted the EPA's request, and that court later dismissed all pending challenges to the rule on July 28, 2015 but it remanded some state budgets to the EPA for further consideration. CSAPR Phase 1 implementation began in 2015, with Phase 2 beginning in 2017. CSAPR generally requires greater reductions than under CAIR. As a result, some coal-fired power plants will be required to install costly pollution controls or shut down which may adversely affect the demand for coal. Finally, in October 2016, the EPA issued an update to the CSAPR to address interstate transport of air pollution under the more recent 2008 ozone NAAQS and the state budgets remanded by the D.C. Circuit. Consolidated judicial challenges to the rule are now pending, but on August 10, 2017, the D.C. Circuit suspended briefing in the litigation after industry petitioners challenging the rule requested to delay proceedings so the EPA can determine whether to reconsider the revised CSAPR. On June 29, 2018, the EPA issued a proposed determination that the 2016 CSAPR Update Rule fully addresses states' interstate transport obligations under the 2008 ozone NAAQS. However, the EPA has also signaled in a variety of 2018 memoranda that states may have more flexibility to consider international emissions and higher thresholds in developing SIPs than under prior guidance. It is not clear how the combination of upholding the 2016 CSAPR Update Rule while allowing greater SIP flexibility will affect decisions to install controls or shut down units, and any resulting effects on the demand for coal. On September 13, 2019 the D.C. Circuit upheld most of the 2016 CSAPR Update Rule, but vacated a provision that allowed upwind states to continue to contribute significantly to downwind states' noncompliance beyond downwind states' statutory compliance deadlines. On October 15, 2020, EPA proposed the Revised CSAPR Update Rule in order to address 21 states' outstanding interstate pollution transport obligations for the 2008 NAAQS. On April 30, 2021, the EPA published the final rule, 86 Fed. Reg. 23,054, entitled the "Revised Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS." The Revised CSAPR Update Rule became effective on June 29, 2021, and was challenged by the "Midwest Ozone Group," a collection of utilities and industry entities. That case remains pending in the D.C. Circuit. If the CSAPR Update Rule is upheld, this may affect demand for coal.

- *Mercury.* In February 2008, the D.C. Circuit vacated the EPA's Clean Air Mercury Rule (CAMR), which was promulgated to reduce mercury emissions from coal-fired power plants and remanded it to the EPA for reconsideration. In response, the EPA announced an Electric Generating Unit (EGU) Mercury and Air Toxics Standard (MATS) on December 16, 2011. The MATS was finalized April 16, 2012, and required compliance for most plants by 2015. In addition, before the court decision vacating the CAMR, some states had either adopted the CAMR or adopted state-specific rules to regulate mercury emissions from power plants that are more stringent than the CAMR. MATS compliance, coupled with state mercury and air toxics laws and other factors have required many plants to install costly controls, re-fire with natural gas or retire, which may adversely affect the demand for coal.

  MATS was challenged in the D.C. Circuit, which upheld the rule on April 15, 2013. Petitioners successfully obtained Supreme Court review, and on June 29, 2015, the Supreme Court issued a 5-4 decision striking down the final rule based on the EPA's failure to consider economic costs in determining whether to regulate. The case was remanded to the D.C. Circuit. The EPA began reconsideration of costs, and petitioners unsuccessfully sought a stay of the rule in the Supreme Court in February 2016. In April 2016, the EPA issued a MATS 2016 Supplemental Finding, a final finding that it is appropriate and necessary to set standards for emissions of air toxics from coal- and oil-fired power plants. On December 27, 2018, the EPA released a proposed Supplemental Cost Finding, concluding that direct regulation of air toxics from coal- and oil-fired power plants is not cost-justified, but proposing to leave the emissions standards and other requirements of the 2012 rule in place. On May 22, 2020, the EPA released a final Supplemental Finding, again concluding that it is not "appropriate and necessary" to regulate EGUs under section 112 of the CAA. The EPA also took final action on the residual risk and technology review (RTR) required by CAA section 112. The results from the RTR showed that emissions of hazardous air pollutants (HAPs) had been reduced such that residual risk is at acceptable levels, there are no developments in HAP emissions controls to achieve further cost-effective reductions beyond the current standards, and, therefore, that no changes to the MATS rule were warranted. However, in the January 20, 2021 Executive Order, the Biden Administration announced a review of the rule in conjunction with other climate-related regulations, and is considering revisiting the "appropriate and necessary" determination and reversing the Supplemental Finding.

- *Regional Haze.* The EPA has initiated a regional haze program designed to protect and improve visibility at and around national parks, national wilderness areas and international parks, particularly those located in the southwest and southeast United States. Under the Regional Haze Rule, affected states were required to submit regional haze SIPs by December 17, 2007, that, among other things, were to identify facilities that would have to reduce emissions and comply with stricter emission limitations. The vast majority of states failed to submit their plans by December 17, 2007, and the EPA issued a Finding of Failure to Submit plans on January 15, 2009 (74 Fed. Reg. 2392). The EPA had taken no enforcement action against states to finalize implementation plans and was slowly dealing with the state Regional Haze SIPs that were submitted, which resulted in the National Parks Conservation Association commencing litigation in the D.C. Circuit on August 3, 2012, against the EPA for failure to enforce the rule *(National Parks Conservation Act v. EPA, D.C. Cir).* Industry groups, including the Utility Air Regulatory Group intervened.

  The EPA ultimately agreed in a consent decree with environmental groups to impose regional haze federal implementation plans (FIPs) or to take action on regional haze SIPs before the agency for 42 states and the District of Columbia. The EPA has completed those actions for all but several states in its first planning period (2008-2010). In many eastern states, the EPA has allowed states to meet "best available retrofit control technology" (BART) requirements for power plants through compliance with CAIR and CSAPR (a policy under pending litigation). Other states have had BART imposed on a case-by-case basis, and where the EPA found SIPs deficient, it disapproved them and issued FIPs. It is possible that the EPA may continue to increase the stringency of control requirements imposed under the Regional Haze Program as it moves toward the next planning period.

This program may result in additional emissions restrictions from new coal-fueled power plants whose operations may impair visibility at and around federally protected areas. This program may also require certain existing coal-fueled power plants to install additional control measures designed to limit haze-causing emissions, such as sulfur dioxide, nitrogen oxides, volatile organic chemicals and particulate matter. These limitations could affect the future market for coal. However, on January 18, 2018, the EPA announced that it was revisiting the 2017 Regional Haze Rule revisions, and announced an intent to commence a new rulemaking. On September 11, 2018, the EPA released a "Regional Haze Reform Roadmap" and reaffirmed its commitment to additional rulemaking.

On August 20, 2019, EPA issued guidance to states in preparing SIPs to meet the 2021 deadline, highlighting state flexibility. In September 2021, EPA issued a clarification memorandum, narrowing some of the flexibility identified in prior guidance. Regional haze litigation over specific implementation continues, and both evolving guidance and the litigation could affect demand for coal.

- *New Source Review.* A number of pending regulatory changes and court actions are affecting the scope of the EPA's new source review program, which under certain circumstances requires existing coal-fueled power plants to install the more stringent air emissions control equipment required of new plants. One of these pending regulatory changes is the EPA's November 15, 2021 proposed rule on "Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review." The new source review program is continually revised and such revisions may impact demand for coal nationally.

Climate Change. Carbon dioxide, which is defined to be a greenhouse gas, is a by-product of burning coal. Global climate issues, including with respect to greenhouse gases such as carbon dioxide and the relationship that greenhouse gases may have with perceived global warming, continue to attract significant public and scientific attention. For example, the Fourth and Fifth Assessment Reports of the Intergovernmental Panel on Climate Change have expressed concern about the impacts of human activity, especially from fossil fuel combustion, on global climate issues. As a result of the public and scientific attention, several governmental bodies increasingly are focusing on global climate issues and, more specifically, levels of emissions of carbon dioxide from coal combustion by power plants. Future regulation of greenhouse gas emissions in the United States could occur pursuant to future U.S. treaty obligations, statutory or regulatory changes at the federal, state or local level or otherwise.

Demand for coal also may be impacted by international efforts to reduce emissions of greenhouse gases. For example, in December 2015, representatives of 195 nations reached a climate accord that will, for the first time, commit participating countries to lowering greenhouse gas emissions, as discussed further below. Further, the United States and a number of international development banks, such as the World Bank, the European Investment Bank and European Bank for Reconstruction and Development, have announced that they will no longer provide financing for the development of new coal-fueled power plants, subject to very narrow exceptions.

Although the U.S. Congress has considered various legislative proposals that would address global climate issues and greenhouse gas emissions, no such federal proposals have been adopted into law to date. In the absence of U.S. federal legislation on these topics, the EPA has been the primary source of federal oversight, although future regulation of greenhouse gases and global climate matters in the United States could occur pursuant to future U.S. treaty obligations, statutory or regulatory changes under the Clean Air Act, federal adoption of a greenhouse gas regulatory scheme or otherwise.

In 2007, the U.S. Supreme Court held that the EPA has authority under the Clean Air Act to regulate carbon dioxide emissions from automobiles and can decide against regulation only if the EPA determines that carbon dioxide does not significantly contribute to climate change and does not endanger public health or the environment. Although the Supreme Court's holding did not expressly involve the EPA's authority to regulate greenhouse gas emissions from stationary sources, such as coal-fueled power plants, the EPA since has determined on its own that it has the authority to regulate greenhouse gas emissions from power plants, and the EPA has published a formal determination that six greenhouse gases, including carbon dioxide, endanger both the public health and welfare of current and future generations.

In 2014, the EPA proposed a sweeping rule, known as the "Clean Power Plan," to cut carbon emissions from existing electric generating units, including coal-fired power plants. A final version of the Clean Power Plan was adopted in August 2015. The final version of the Clean Power Plan aims to reduce carbon dioxide emissions from electrical power generation by 32% by 2030 relative to 2005 levels through reduction of emissions from coal-burning power plants and increased use of renewable energy and energy conservation methods. Under the Clean Power Plan, states are free to reduce emissions by various means and must submit emissions reduction plans to the EPA by September 2016 or, with an approved extension, September 2018. If a state has not submitted a plan by then, the Clean Power Plan authorizes the EPA to impose its own plan on that state. In order to determine a state's goal, the EPA has divided the country into three regions based on connected regional electricity grids. States are to implement their plans by focusing on (i) increasing the generation efficiency of existing fossil fuel plants, (ii) substituting lower carbon dioxide emitting natural gas generation for coal-powered generation and (iii) substituting generation from new zero carbon dioxide emitting renewable sources for fossil fuel powered generation. States are permitted to use regionally available low carbon generation sources when substituting for in-state coal generation and coordinate with other states to develop multi-state plans. Following the adoption, 27 states sued the EPA, claiming that the EPA overstepped its legal authority in adopting the Clean Power Plan. In February 2016, the U.S. Supreme Court ordered the EPA to halt enforcement of the Clean Power Plan until a lower court rules on the lawsuit and until the Supreme Court determines whether or not to hear the case. In October 2017, the EPA commenced rulemaking proceedings to rescind the Clean Power Plan, and in December 2017, the EPA published an Advanced Notice of Proposed Rulemaking announcing an intent to commence a new rulemaking to replace the Clean Power Plan with an alternative framework for regulating carbon dioxide.

In a parallel litigation, 25 states and other parties filed lawsuits challenging the EPA's final New Source Performance Standards rules, which we refer to as NSPS, for carbon dioxide emissions from new, modified, and reconstructed power plants under the Clean Air Act. One of the primary issues in these lawsuits is the EPA's establishment of standards of performance based on technologies including carbon capture and sequestration, which we refer to as CCS. New coal plants cannot meet the new standards unless they implement CCS, which reportedly is not yet commercially available or technically feasible. In conjunction with the EPA's proposal to rescind the Clean Power Plan, the EPA also requested a stay of the NSPS litigation. The D.C. Circuit granted the request, and the litigation has been held in abeyance since then.

On June 19, 2019, the EPA finalized the Affordable Clean Energy (ACE) rule as a replacement for the Clean Power Plan. The ACE rule establishes emission guidelines for states to develop plans to address greenhouse gas emissions from existing coal-fired power plants. The ACE rule has several components: a determination of the best system of emission reduction for greenhouse gas emissions from coal-fired power plants, a list of "candidate technologies" states can use when developing their plans, a new preliminary applicability test for determining whether a physical or operational change made to a power plant may be a "major modification" triggering New Source Review, and new implementing regulations for emission guidelines under Clean Air Act section 111(d). On January 19, 2021, the D.C. Circuit Court of Appeals vacated the ACE rule and its implied repeal of the Clean Power Plan, remanding to the EPA for further proceedings. As the remand was proceeding, the Supreme Court agreed to revisit the EPA's authority to regulate carbon emissions under Clean Air Act section 111(d). In ***West Virginia v. EPA***, No. 20-1530 and three other consolidated cases, the Court is considering the agency's authority to regulate emissions sector-wide rather than on individual sources, limits on the agency's ability to direct States to take action, and the range of factors the agency can consider in rulemaking under section 111(d). These issues implicate not only the ACE, but potentially a variety of other rules related to coal combustion. A decision is expected by June 2022.

In December 2015, 195 nations (including United States) signed the Paris Agreement, a long-term, international framework convention designed to address climate change over the next several decades. This agreement entered into force in November 2016 after more than 70 countries, including the United States, ratified or otherwise agreed to be bound by the agreement. The United States was among the countries that submitted its declaration of intended greenhouse gas reductions in early 2015, stating its intention to reduce U.S. greenhouse gas emissions by 26-28% by 2025 compared to 2005 levels. Whether and to what extent the United States meets its stated intention likely depends on several factors, including whether the ACE rule is implemented. In June 2017, The Trump Administration announced the United States intends to withdraw from the Paris Agreement. In November 2019, The Trump administration formally initiated the withdrawal process, and formally exited the Agreement on November 4, 2020. President Biden has recommitted the United States to the Paris Agreement and, in April 2021, announced a goal of reducing the United

States' emissions by 50-52% below 2005 levels by 2030. In November 2021, President Biden released "The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050," which, among other things, explains that the U.S. and EU are co-leading the "Global Methane Pledge" that aims to cut global methane pollution at least 30% by 2030 relative to 2020 levels. President Biden also agreed that same month to cooperate with Chinese leader Xi Jinping on accelerating progress toward the adoption of clean energy. Regardless of the extent to which the United States ultimately participates in these reductions, over the long term, international participation in the Paris Agreement framework could reduce overall demand for coal which could have a material adverse impact on us. These effects could be more adverse to the extent the United States ultimately participates in these reductions (whether via the Paris Agreement or otherwise).

Several U.S. states have enacted legislation establishing greenhouse gas emissions reduction goals or requirements or joined regional greenhouse gas reduction initiatives. Some states also have enacted legislation or regulations requiring electricity suppliers to use renewable energy sources to generate a certain percentage of power or that provide financial incentives to electricity suppliers for using renewable energy sources. For example, eleven northeastern and mid-Atlantic states currently are members of the Regional Greenhouse Gas Initiative, which is a mandatory cap-and-trade program established in 2005 to cap regional carbon dioxide emissions from power plants. Six Midwestern states and one Canadian province entered into the Midwestern Regional Greenhouse Gas Reduction Accord to establish voluntary regional greenhouse gas reduction targets and develop a voluntary multi-sector cap-and-trade system to help meet the targets, although it has been reported that the members no longer are actively pursuing the group's activities. Lastly, California and Quebec remain members of the Western Climate Initiative, which was formed in 2008 to establish a voluntary regional greenhouse gas reduction goal and develop market-based strategies to achieve emissions reductions, and those two jurisdictions have adopted their own greenhouse gas cap-and-trade regulations. Several states and provinces that originally were members of these organizations, as well as some current members, have joined the new North America 2050 initiative, which seeks to reduce greenhouse gas emissions and create economic opportunities aside from cap-and-trade programs. Any particular state, or any of these or other regional group, may have or adopt in the future rules or policies that cause some users of coal to switch from coal to a lower carbon fuel. There can be no assurance at this time that a carbon dioxide cap-and-trade-program, a carbon tax or other regulatory or policy regime, if implemented by any one or more states or regions in which our customers operate or at the federal level, will not affect the future market for coal in those states or regions and lower the overall demand for coal.

Clean Water Act. The federal Clean Water Act (sometimes shortened to CWA) and corresponding state and local laws and regulations affect coal mining operations by restricting the discharge of pollutants, including dredged and fill materials, into waters of the United States. The Clean Water Act provisions and associated state and federal regulations are complex and subject to amendments, legal challenges and changes in implementation. Recent court decisions and regulatory actions have created uncertainty over Clean Water Act jurisdiction and permitting requirements that could variously increase or decrease the cost and time we expend on Clean Water Act compliance.

The scope of waters that fall within the Clean Water Act's jurisdiction is expansive and may include features not commonly understood to be a stream or wetland. In June 2015, the EPA and the Army Corps of Engineers (the "Corps") issued a new rule defining the scope of "waters of the United States" (WOTUS) that are subject to regulation. The 2015 WOTUS rule was challenged by a number of states and private parties in various federal courts. In December 2017, the EPA and the Corps proposed a rule to repeal the 2015 WOTUS rule. The repeal took effect on December 23, 2019. In December 2018, the EPA and Corps also formally proposed a new rule revising the definition of WOTUS. The new rule -- the Navigable Waters Protection Rule ("NWPR") -- became effective on June 22, 2020 and substantially reduced the scope of waters that fall within the Clean Water Act's jurisdiction, in part by excluding ephemeral streams, which potentially qualified as "Waters of the United States" under the 2015 WOTUS rule. Numerous challenges to the NWPR were filed, and in 2021 under the new Biden administration, the EPA and the Corps asked the courts in the pending litigation to remand the NWPR for agency reconsideration but to maintain the effect of the NWPR in the interim. In August 2021, a federal district court in Arizona declined the request and vacated the NWPR without specifying whether its decision applied nationwide. However, the EPA and the Corps announced on September 3, 2021 that they would revert to the pre-2015 rule until further notice. On December 7, 2021, the EPA and the Corps announced a new proposed rule, which would largely retain the pre-2015 regulatory framework with the addition of other waters that meet the "relatively permanent" or "significant nexus" standards. On January 24, 2022, the U.S. Supreme Court decided to hear a challenge to EPA's interpretation of WOTUS.

Clean Water Act requirements that may directly or indirectly affect our operations include the following:

- Water Discharge. Section 402 of the Clean Water Act creates a process for establishing effluent limitations for discharges to streams that are protective of water quality standards through the National Pollutant Discharge Elimination System, which we refer to as the NPDES, or an equally stringent program delegated to a state regulatory agency. Regular monitoring, reporting and compliance with performance standards are preconditions for the issuance and renewal of NPDES permits that govern discharges into waters of the United States. Discharges that exceed the limits specified under NPDES permits can lead to the imposition of penalties, and persistent non-compliance could lead to significant penalties, compliance costs and delays in coal production. In addition, the imposition of future restrictions on the discharge of certain pollutants into waters of the United States could increase the difficulty of obtaining and complying with NPDES permits, which could impose additional time and cost burdens on our operations.

- Discharges of pollutants into waters that states have designated as impaired (i.e., as not meeting present water quality standards) are subject to Total Maximum Daily Load, which we refer to as TMDL, regulations. The TMDL regulations establish a process for calculating the maximum amount of a pollutant that a water body can receive while maintaining state water quality standards. Pollutant loads are allocated among the various sources that discharge pollutants into that water body. Mine operations that discharge into water bodies designated as impaired will be required to meet new TMDL allocations. The adoption of more stringent TMDL-related allocations for our coal mines could require more costly water treatment and could adversely affect our coal production.

  The Clean Water Act also requires states to develop anti-degradation policies to ensure that non-impaired water bodies continue to meet water quality standards. The issuance and renewal of permits for the discharge of pollutants to waters that have been designated as “high quality” are subject to anti-degradation review that may increase the costs, time and difficulty associated with obtaining and complying with NPDES permits.

  Under the Clean Water Act, citizens may sue to enforce NPDES permit requirements. Beginning in 2012, multiple citizens’ suits were filed in West Virginia against mine operators for alleged violations of NPDES permit conditions requiring compliance with West Virginia’s water quality standards. Some of the lawsuits alleged violations of water quality standards for selenium, whereas others alleged that discharges of conductivity and sulfate were causing violations of West Virginia water quality standards that prohibit adverse effects to aquatic life. The suits sought penalties as well as injunctive relief that would limit future discharges of selenium, conductivity or sulfate through the implementation of expensive treatment technologies. The federal district court for the Southern District of West Virginia has ruled in favor of the citizen suit groups in multiple suits alleging violations of the water quality standard for selenium and in two suits alleging violations of water quality standards due to discharge of conductivity (one of which was upheld on appeal by the United States Court of Appeals for the Fourth Circuit in January 2017). In 2015, the West Virginia Legislature amended the West Virginia Water Pollution Control Act and associated rules to expressly prohibit the direct enforcement of water quality standards against permit holders. On March 27, 2019, the EPA approved these changes.

  Citizens may also sue under the Clean Water Act when pollutants are being discharged without NPDES permits. Beginning in 2013, multiple citizens’ suits were filed in West Virginia against landowners alleging ongoing discharges of pollutants, including selenium and conductivity, from valley fills at reclaimed mining sites. In each case, the reclamation bond had been released and the mining and NPDES permits had been terminated following the completion of reclamation. While it is difficult to predict the outcome of such suits, any determination that discharges from valley fills require NPDES permits could result in increased compliance costs following the completion of mining at our operations.

- *Dredge and Fill Permits.* Many mining activities, such as the development of refuse impoundments, fresh water impoundments, refuse fills, valley fills, and other similar structures, may result in impacts to waters of the United States, including wetlands, streams and, in certain instances, man-made conveyances that

have a hydrologic connection to such streams or wetlands. Under the Clean Water Act, coal companies are required to obtain a Section 404 permit from the Corps, prior to conducting such mining activities. The Corps is authorized to issue general "nationwide" permits for specific categories of activities that are similar in nature and that are determined to have minimal adverse effects on the environment. Permits issued pursuant to Nationwide Permit 21, which we refer to as NWP 21, generally authorize the disposal of dredged and fill material from surface coal mining activities into waters of the United States, subject to certain restrictions. Since March 2007, permits under NWP 21 were reissued for a five-year period with new provisions intended to strengthen environmental protections. There must be appropriate mitigation in accordance with nationwide general permit conditions rather than less restricted state-required mitigation requirements, and permit holders must receive explicit authorization from the Corps before proceeding with proposed mining activities. Notwithstanding the additional environmental protections designed in the NWP 21, on July 15, 2009, the Corps proposed to immediately suspend the use of NWP 21 in six Appalachian states, including West Virginia, Kentucky and Virginia where the Company conducts operations. On June 17, 2010, the Corps announced that it had suspended the use of NWP 21 in the same six states although it remained for use elsewhere. In February 2012, the Corps proposed to reissue NWP 21, albeit with significant restrictions on the acreage and length of stream channel that can be filled in the course of mining operations. The Corps' decisions regarding the use of NWP 21 does not prevent the Company's operations from seeking an individual permit under § 404 of the CWA, nor does it restrict an operation from utilizing another version of the nationwide permit, NWP 50, authorized for small underground coal mines that must construct fills as part of their mining operations. On January 13, 2021, the Corps published a final rule modifying its NWP program. The final rule replaced several of the 2017 NWPs, including NWP 21 and NWP 50, and added several new NWPs. The Corps removed the provision in NWP 21 and NWP 50 requiring the permittee to "receive a written authorization" from the Corps before commencing the covered activity.

Resource Conservation and Recovery Act. The Resource Conservation and Recovery Act, which we refer to as RCRA, may affect coal mining operations through its requirements for the management, handling, transportation and disposal of hazardous wastes. Many mining wastes are excluded from the regulatory definition of hazardous wastes, and coal mining operations covered by SMCRA permits are by statute exempted from RCRA permitting. RCRA also allows the EPA to require corrective action at sites where there is a release of hazardous substances. In addition, each state has its own laws regarding the proper management and disposal of waste material. In June 2010, the EPA released a proposed rule to regulate the disposal of certain coal combustion residuals, which we refer to as CCR. The proposed rule set forth two very different options for regulating CCR under RCRA. The first option called for regulation of CCR as a hazardous waste under Subtitle C, which creates a comprehensive program of federally enforceable requirements for waste management and disposal. The second option utilized Subtitle D, which would give the EPA authority to set performance standards for waste management facilities and would be enforced primarily through citizen suits. The proposal left intact the so-called Bevill exemption for beneficial uses of CCR. The EPA finalized the CCR rule on December 19, 2014, setting nationwide solid nonhazardous waste standards for CCR disposal. On April 17, 2015, the EPA finalized regulations under the solid waste provisions (Subtitle D) of RCRA and not the hazardous waste provisions (Subtitle C) which became effective on October 19, 2015. The final rule establishes national minimum criteria for existing and new CCR landfills, surface impoundments and lateral expansions, and also establishes structural integrity criteria for new and existing surface impoundments (including establishing requirements for owners and operators to conduct periodic structural integrity-related assessments). The criteria include location restrictions, design and operating criteria, groundwater monitoring and corrective action, closure requirements and post-closure care and recordkeeping, notification and internet posting requirements. While classification of CCR as a hazardous waste would have led to more stringent restrictions and higher costs, this regulation may still increase our customers' operating costs and potentially reduce their ability to purchase coal. In addition, contamination caused by the past disposal of CCR, including coal ash, could lead to citizen suit enforcement against our customers under RCRA or other federal or state laws and potentially reduce the demand for coal. In another development regarding coal combustion wastes, the EPA conducted an assessment of impoundments and other units that manage residuals from coal combustion and that contain free liquids following a massive coal ash spill in Tennessee in 2008. The EPA contractors conducted site assessments at many impoundments and is requiring appropriate remedial action at any facility that is found to have a unit posing a risk for potential failure. The EPA is posting utility responses to the assessment on its web site as the responses are received. After industry groups filed a suit in the D.C. Circuit, challenging the 2015 rule, former EPA Administrator Pruitt issued

a letter on September 13, 2017 indicating the agency's decision to reconsider the rule in response to industry petitions. On August 22, 2018, the D.C. Circuit remanded the rule at the EPA's request. On August 28, 2020, the EPA issued a final revised rule that modifies standards regarding beneficial use and assessing environmental harm, and extends deadlines for regulated entities to come into compliance. Environmental groups sought to challenge the rule, but the petition was untimely and was voluntarily dismissed. Future regulations resulting from the EPA coal combustion refuse assessments may impact the ability of the Company's utility customers to continue to use coal in their power plants.

Comprehensive Environmental Response, Compensation and Liability Act. The Comprehensive Environmental Response, Compensation and Liability Act, which we refer to as CERCLA, and similar state laws affect coal mining operations by, among other things, imposing cleanup requirements for threatened or actual releases of hazardous substances that may endanger public health or welfare or the environment. Under CERCLA and similar state laws, joint and several liability may be imposed on waste generators, site owners and lessees and others regardless of fault or the legality of the original disposal activity. Although the EPA excludes most wastes generated by coal mining and processing operations from the hazardous waste laws, such wastes can, in certain circumstances, constitute hazardous substances for the purposes of CERCLA. In addition, the disposal, release or spilling of some products used by coal companies in operations, such as chemicals, could trigger the liability provisions of the statute. Thus, coal mines that we currently own or have previously owned or operated, and sites to which we sent waste materials, may be subject to liability under CERCLA and similar state laws. In particular, we may be liable under CERCLA or similar state laws for the cleanup of hazardous substance contamination at sites where we own surface rights.

Endangered Species. The Endangered Species Act and other related federal and state statutes protect species threatened or endangered with possible extinction. Protection of threatened, endangered and other special status species may have the effect of prohibiting or delaying us from obtaining mining permits and may include restrictions on timber harvesting, road building and other mining or agricultural activities in areas containing the affected species. A number of species indigenous to our properties are protected under the Endangered Species Act or other related laws or regulations. Based on the species that have been identified to date and the current application of applicable laws and regulations, however, we do not believe there are any species protected under the Endangered Species Act that would materially and adversely affect our ability to mine coal from our properties in accordance with current mining plans. We have been able to continue our operations within the existing spatial, temporal and other restrictions associated with special status species. In its final rule published on December 16, 2020, the FWS adopted a regulatory definition of "habitat" for the first time, which could have important consequences for future designations of "critical habitat" under the Endangered Species Act. In October 2021, the Biden administration published rules that changed the definition of "habitat" and altered a policy that made it easier to exclude territory from critical habitat. Designation of critical habitat by the FWS can affect projects that require federal agency permits or funding, because section 7 of the Endangered Species Act requires federal agencies to ensure, through consultation with the FWS, that their actions are not likely to adversely modify or destroy designated critical habitat. Should more stringent protective measures be developed and applied to threatened, endangered or other special status species or to their critical habitat, then we could experience increased operating costs or difficulty in obtaining future mining permits.

Use of Explosives. Our surface mining operations are subject to numerous regulations relating to blasting activities. Pursuant to these regulations, we incur costs to design and implement blast schedules and to conduct pre-blast surveys and blast monitoring. In addition, the storage of explosives is subject to strict regulatory requirements established by four different federal regulatory agencies. For example, pursuant to a rule issued by the Department of Homeland Security in 2007, facilities in possession of chemicals of interest, including ammonium nitrate at certain threshold levels, must complete a screening review in order to help determine whether there is a high level of security risk such that a security vulnerability assessment and site security plan will be required.

Other Environmental Laws. We are required to comply with numerous other federal, state and local environmental laws in addition to those previously discussed. These additional laws include, for example, the Safe Drinking Water Act, the Toxic Substance Control Act and the Emergency Planning and Community Right-to-Know Act.

Human Capital Resources

At December 31, 2021, Arch and its subsidiaries currently employ more than 3,300 people that are non-unionized in the United States and three employees overseas. Management believes that it has good relations with its employees.

Arch's responsible and respectful corporate culture has allowed it to attract and retain an experienced, talented and high-performing workforce. The Company and its subsidiaries had an average voluntary retention rate of 89% in 2021. Approximately 40% of the Company's workforce had at least 10 years of Company service in 2021.

Health and Safety. Safety is a deeply engrained value at Arch. We have consistently led our large, integrated peers in safety performance, as measured by lost-time incident rate.

The Company averaged 1.01 lost-time incidents per 200,000 employee-hours worked at December 31, 2021 in comparison to a national average lost-time incident rate of 2.36 (which represents the national average through the third quarter of 2021).

Across the organization, employees engage in a proactive, behavior-based approach to safety. Every field employee participates in safety training on an ongoing basis, and nearly 100 percent of our field employees have been trained as safety observers. If an at-risk behavior or a barrier to safe behavior is identified, employees are empowered to engage and to apply their training to resolve the potentially unsafe condition or practice immediately.

Since launching the behavior-based program in 2007, Arch's operating subsidiaries have recorded a total of 1.47 million safety observations and in so doing have created a deep, employee-driven safety culture. Most importantly, the process has resulted in the successful modification of at-risk behaviors and has served as a platform for reinforcing positive behaviors. In addition, Arch operations conduct safety meetings in advance of every shift, to ensure that every employee begins every workday sharply focused on working safely.

During the year, Arch's subsidiary operations also claimed two Sentinels of Safety awards, the nation's highest distinction for mine safety; the Department of Interior's Good Neighbor Award, the nation's highest honor for community outreach and engagement; the Milestones of Safety Award, the state of West Virginia's top safety honor; and the Greenlands Award, the state of West Virginia's top reclamation honor. Leer and Leer South – the Company's flagship operations set the Company standard by claiming three of these major awards.

Our safety focus is also evident in our response to the COVID-19 pandemic. We have instituted many policies and procedures, in alignment with CDC guidelines state and local mandates, to protect our employees during the COVID-19 outbreak. These policies and procedures include, but are not limited to, staggering shift times to limit the number of people in common areas at one time, limiting meetings and meeting sizes, wearing masks, vaccine incentives, continual cleaning and disinfecting of high touch and high traffic areas, including door handles, bath rooms, bath houses, access elevators, mining equipment, and other areas, limiting contractor access to our properties, limiting business travel, and instituting work from home for administrative employees. We continually evaluate our policies and procedures, in accordance with CDC, state, and local guidelines, and make any necessary adjustments to respond to the particular circumstances in the areas in which we operate. Vaccination rates among our workforce have leveled off during the second half of 2021, in alignment with national and local trends. Furthermore, the advent of the Delta and Omicron variants has led to increased infection rates among our workforce at certain operations, in alignment with national and local trends. We have reinstated stricter protocols at affected operations. During the second half of 2021, over fifty unit production shifts in our metallurgical segment were adversely impacted by staffing shortfalls related to increased COVID-19 case rates, and our requisite quarantine protocols. We continue to encourage vaccination among our workforce and adjust our COVID-19 responses.

Training and Development. We recognize the importance of furthering education and development of its employees through the various stages of their careers. To that end, we offer free access to thousands of courses that are designed for personal and career development through an online education platform. A number of these courses are tailored so employees can earn Continuing Education Units (CEU), Professional Development Hours (PDH), and

Professional Engineering (PE) Units to fulfill accreditation requirements. Additionally, employees are eligible for a tuition reimbursement benefit through a program designed to encourage and support development of employee skills by providing financial assistance for an approved course of study. In the past five years, Arch's tuition reimbursement program totaled more than $1 million. These programs reflect our view that ongoing employee development is good business as well as a valuable benefit that can help attract and retain talented and skilled people.

We also invest significantly in the development of its next generation of leaders. Over the past five years, Arch has designed and conducted ongoing multi-day leadership workshops designed to educate high-potential corporate and subsidiary employees about our strategic direction, financial position, asset base and corporate culture, as well as to enhance leadership skillsets. More than 450 high-potential employees have participated in those workshops, with the Company's senior management team and other senior leaders participating in the training sessions.

In addition, we hold a safety and environmental stewardship summit at our headquarters location in Saint Louis each year. More than 240 employees from all subsidiary mine sites in addition to the senior leadership team and corporate employees participate in this summit each year, which creates opportunities for sharing best practices across the operations while reinforcing the Company's deep commitment to excellence in these critical areas of performance.

Information about our Executive Officers

The following is a list of our executive officers, their ages as of February 16, 2022 and their positions and offices during the last five years:

Name	Age	Position
Paul T. Demzik	60	Mr. Demzik has served as our Senior Vice President and Chief Commercial Officers since January 2019. From June 2013 to January 2019, Mr. Demzik served as Head of Thermal Coal Trading with Anglo American Marketing Limited in London and served as President of Peabody COALTRADE, LLC from July 2005 to July 2012.
John T. Drexler	52	Mr. Drexler has served as our Senior Vice President and Chief Operating Officer since 2020. Mr. Drexler served as our Senior Vice President and Chief Financial Officer from 2008 to 2020 and our Vice President-Finance and Accounting from 2006 to 2008. From 2005 to 2006, Mr. Drexler served as our Director of Planning and Forecasting. Prior to 2005, Mr. Drexler held several other positions within our finance and accounting department. Mr. Drexler also served on the board of Knight Hawk Holdings, LLC.
John W. Eaves	64	Mr. Eaves has served as our Executive Chairman of the Board of Directors since retiring as Chief Executive Officer in 2020. Mr. Eaves was our Chief Executive Officer from 2012 to 2020. Mr. Eaves served as our Chairman of the Board from 2015 to 2016 and our President and Chief Operating Officer from 2006 to 2012. From 2002 to 2006, Mr. Eaves served as our Executive Vice President and Chief Operating Officer. Mr. Eaves currently serves on the board of the CF Industries Holdings, Inc. Mr. Eaves was previously a Director of Advanced Emissions Solutions, Inc., The National Association of Manufacturers, The National Mining Association, and former Chairman of the National Coal Council.
Matthew C. Giljum	50	Mr. Giljum has served as our Chief Financial Officer since 2020. Mr. Giljum served as our Vice President of Finance and Treasurer from 2015 to 2020. Prior to that role, he served as the Company's Vice President of Finance, as well as a number of other positions of increasing responsibility in the Company's finance department.
Rosemary L. Klein	54	Ms. Klein has served as our Senior Vice President - Law, General Counsel and Secretary since October 2020. Prior to that she served as special counsel in the Company's legal department since 2015. Prior to joining the Company in 2015, Ms. Klein served as general counsel and corporate secretary - and held other senior leadership roles - at several multinational, publicly held corporations, including Solutia Inc. and Spartech Corporation.
Paul A. Lang	61	Mr. Lang has served as our President and Chief Executive Officer since 2020. Mr. Lang served as our President and Chief Operating Officer since April 2015 and has served as our Executive Vice President and Chief Operating Officer since April 2012 and as our Executive Vice President-Operations from August 2011 to April 2012. Mr. Lang served as Senior Vice President-Operations from 2006 through August 2011, as President of Western Operations from 2005 through 2006 and President and General Manager of Thunder Basin Coal Company from 1998 to 2005. Mr. Lang is a member of the Board of The National Mining Association. Mr. Lang has also served as Director of Knight Hawk Holdings, LLC and served on the development board of the Mining Department of the Missouri University of Science & Technology, and is the former chairman of the University of Wyoming's School of Energy Resources Council.
Deck S. Slone	58	Mr. Slone has served as our Senior Vice President-Strategy and Public Policy since June 2012. Mr. Slone served as our Vice President-Government, Investor and Public Affairs from 2008 to June 2012. Mr. Slone served as our Vice President-Investor Relations and Public Affairs from 2001 to 2008. In the past Mr. Slone served as the chairman of the National Coal Council, the co-chair of the Carbon Utilization Research Council, and the Chair of the National Mining Association's Energy Policy Task Force.
John A. Ziegler, Jr.	55	Mr. Ziegler has served as our Senior Vice President & Chief Administrative Officer since January 2019. Mr. Ziegler served as our Chief Commercial Officer since March 2014. Mr. Ziegler served as our Vice President-Human Resources from April 2012 to March 2014. From October 2011 to April 2012, Mr. Ziegler served as our Senior Director-Compensation and Benefits. From 2005 to October 2011 Mr. Ziegler served as Vice President-Contract Administration, President of Sales, then finally Senior Vice President, Sales and Marketing and Marketing Administration. Mr. Ziegler joined Arch in 2002 as Director-Internal Audit. Prior to joining Arch Resources, Mr. Ziegler held various finance and accounting positions with bioMerieux and Ernst & Young.

Available Information

We file annual, quarterly and current reports, and amendments to those reports, proxy statements and other information with the Securities and Exchange Commission. You may access and read our filings without charge through the SEC's website, at *sec.gov*.

We also make the documents listed above available without charge through our website, *archrsc.com*, as soon as practicable after we file or furnish them with the SEC. You may also request copies of the documents, at no cost, by telephone at (314) 994-2700 or by mail at Arch Resources, Inc., 1 CityPlace Drive, Suite 300, St. Louis, Missouri, 63141 Attention: Senior Vice President-Strategy and Public Policy. The information on our website is not part of this Annual Report on Form 10-K.

GLOSSARY OF SELECTED MINING TERMS

Certain terms that we use in this document are specific to the coal mining industry and may be technical in nature. The following is a list of selected mining terms and the definitions we attribute to them.

Bituminous coal	Coal used primarily to generate electricity and to make coke for the steel industry with a heat value ranging between 10,500 and 15,500 Btus per pound.
Btu	A measure of the energy required to raise the temperature of one pound of water one degree of Fahrenheit.
Coking coal	Coal used to produce coke, the primary source of carbon used in steelmaking.
Compliance coal	Coal which, when burned, emits 1.2 pounds or less of sulfur dioxide per million Btus, requiring no blending or other sulfur dioxide reduction technologies in order to comply with the requirements of the Clean Air Act.
Continuous miner	A machine used in underground mining to cut coal from the seam and load it onto conveyors or into shuttle cars in a continuous operation.
Dragline	A large machine used in surface mining to remove the overburden, or layers of earth and rock, covering a coal seam. The dragline has a large bucket, suspended by cables from the end of a long boom, which is able to scoop up large amounts of overburden as it is dragged across the excavation area and redeposit the overburden in another area.
Hard coal	Coking coal of gross calorific value greater than 5700 kcal/kg on an ash free but moist basis and further disaggregated into anthracite, coking coal and other bituminous coal.
High-Vol A	A coking coal used in steel production with a volatile matter content between 31% and 34.5% on a dry basis.
High-Vol B	A coking coal used in steel production with a volatile matter content between 34.5% and 38% on a dry basis.
Indicated mineral resource	Indicated mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Because an indicated mineral resource has a lower level of confidence than the level of confidence of a measured mineral resource, an indicated mineral resource may only be converted to a probable mineral reserve.
Inferred mineral resource	Inferred mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Because an inferred mineral resource has the lowest level of geological confidence of all mineral resources, which prevents the application of the modifying factors in a manner useful for evaluation of economic viability, an inferred mineral resource may not be considered when assessing the economic viability of a mining project, and may not be converted to a mineral reserve.
Lignite Coal	Coal with the lowest carbon content and a heat value ranging between 4,000 and 8,300 Btus per pound.
Longwall mining	One of two major underground coal mining methods, generally employing two rotating drums pulled mechanically back and forth across a long face of coal.
Low-sulfur coal	Coal which, when burned, emits 1.6 pounds or less of sulfur dioxide per million Btus.
Low-Vol	A coking coal used in steel production with a volatile matter content between 16% and 23% on a dry basis.

Measured mineral resource	Measured mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The level of geological certainty associated with a measured mineral resource is sufficient to allow a qualified person to apply modifying factors, as defined in S-K 1300, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit. Because a measured mineral resource has a higher level of confidence than the level of confidence of either an indicated mineral resource or an inferred mineral resource, a measured mineral resource may be converted to a proven mineral reserve or to a probable mineral reserve.
Metallurgical coal	Coal used in steel production either as coking coal or pulverized coal injection (PCI).
Mid-Vol	A coking coal used in steel production with a volatile matter greater than 22% but less than 31% on a dry basis.
Preparation plant	A facility used for crushing, sizing and washing coal to remove impurities and to prepare it for use by a particular customer.
Probable mineral reserves	Probable mineral reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource.
Proven mineral reserves	Proven mineral reserve is the economically mineable part of a measured mineral resource and can only result from conversion of a measured mineral resource.
Pulverized coal injection coal (PCI)	Coal that is introduced directly into the blast furnace as a source of energy and carbon in the steelmaking process.
Reclamation	The restoration of land and environmental values to a mining site after the coal is extracted. The process commonly includes “recontouring” or shaping the land to its approximate original appearance, restoring topsoil and planting native grass and ground covers.
Qualified Person	Qualified Person or “QP” is an individual who is 1) a mineral industry professional with at least five years of relevant experience in the type of mineralization and type of deposit under consideration and in the specific type of activity that person is undertaking on behalf of the registrant; and 2) an eligible member or license in good standing of a recognized professional organization at the time of the technical report summary (TRS) is prepared.
Reserves	Reserves or mineral reserve is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the qualified person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.
Resources	Resources or mineral resources is a concentration or occurrence of material of economic interest on the earth’s crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.
Room-and-pillar mining	One of two major underground coal mining methods, utilizing continuous miners creating a network of “rooms” within a coal seam, leaving behind “pillars” of coal used to support the roof of a mine.
Subbituminous coal	Coal used primarily to generate electricity with a heat value ranging between 8,300 and 13,000 Btus per pound.
Technical Report Summary (TRS)	A technical report summary or “TRS” report provides a statement a company’s coal reserves and has been prepared by a qualified person “QP” in accordance with the United States Securities and Exchange Commission (SEC), Regulation S-K 1300 for Mining Property Disclosure.

ITEM 1A. RISK FACTORS.

Our business involves certain risks and uncertainties. In addition to the risks and uncertainties described below, we may face other risks and uncertainties, some of which may be unknown to us and some of which we may deem immaterial. The following review of important risk factors should not be construed as exhaustive and should be read in conjunction with other cautionary statements that are included herein or elsewhere. If one or more of these risks or uncertainties occur, our business, financial condition or results of operations may be materially and adversely affected.

Summary Risk Factors

Our business is subject to a number of risks, including risks that may prevent us from achieving our business objectives or may adversely affect our business, financial condition, results of operations, cash flows. These risks are discussed more fully below and include, but are not limited to, risks related to:

Risks Related to Our Operations and Industry

- The COVID-19 pandemic;
- A decline in coal prices;
- Volatile economic and market conditions;
- Operating risks related to our coal mining operations that are beyond our control;
- The loss of availability, reliability and cost-effectiveness of transportation facilities and fluctuations in transportation costs;
- Inflationary pressures and availability of mining and other industrial supplies;
- The effects of foreign and domestic trade policies;
- Competition from alternative fuel sources or subsidized renewables, including with respect to transportation, could put downward pressure on coal prices;
- Our customers are continually evaluating alternative steel production technologies;
- Our ability to operate our business effectively could be impaired if we lose key personnel or fail to attract qualified personnel;
- Changes in purchasing patterns in the coal industry;
- The loss of, or a significant reduction in, purchases by our largest customers;
- Disruptions in the quantities of coal purchased from other third parties;
- International growth in our sales adds new and unique risks to our business;
- Our ability to collect payments from our customers;
- Failure to obtain or renew surety bonds or insurance;
- Inaccuracies in our estimates of our coal reserves;
- A defect in title or the loss of a leasehold interest in certain properties or surface rights;
- We may incur losses as a result of certain marketing and asset optimization strategies;
- Any decrease in the coal consumption of electric power generators could result in less demand and lower prices for thermal coal;
- If we or our service providers sustain cyber-attacks or other security incidents that disrupt our operations or involve unauthorized access to proprietary, confidential or personally identifiable information;
- Our inability to acquire additional coal reserves or our inability to develop coal reserves;
- We may be unable to comply with the restrictions imposed by our Term Loan Debt Facility and other financing arrangements;
- We may be unable to raise the funds necessary to repurchase our convertible notes for cash following a fundamental change, or to pay any cash amounts due upon conversion;

Risks Related to Environmental, Other Regulations and Legislation

- Extensive environmental regulations, including existing and potential future regulatory requirements relating to air emissions, affect our customers and could reduce the demand for coal as a fuel source;
- Increase pressure from political and regulatory authorities, along with environmental activist groups, and lending and investment policies adopted by financial institutions and insurance companies to address concerns about the environmental impacts of coal combustion;
- Increased attention to environmental, social or governance ("ESG") matters could adversely impact our business and the value of the company.
- Our failure to obtain and renew permits necessary for our mining operations could negatively affect our business;
- Federal or state regulatory agencies have the authority to order certain of our mines to be temporarily or permanently closed under certain circumstances;
- Extensive environmental regulations impose significant costs on our mining operations, and future regulations could materially increase those costs or limit our ability to produce and sell coal;
- If the assumptions underlying our estimates of reclamation and mine closure obligations are inaccurate;
- Our operations may impact the environment or cause exposure to hazardous substances, and our properties may have environmental contamination;
- Changes in the legal and regulatory environment could complicate or limit our business activities, increase our operating costs or result in litigation;

Risks Related to Income Taxes

- Our ability to use net operating losses and alternative minimum tax credits is subject to current limitation, and our ability to use net operating losses may be subject to additional limitations;
- U.S. tax legislation may materially adversely affect our financial condition, results of operations and cash flows;

The COVID-19 pandemic has adversely affected, and will continue to adversely affect, our business, financial condition, liquidity and results of operations.

The COVID-19 pandemic has resulted in a widespread health crisis that has adversely affected businesses, economies and financial markets worldwide. The full impact of COVID-19 is unknown and continues to rapidly evolve. While the outbreak appeared to be trending downward, particularly as vaccination rates increased, new variants of COVID-19 continue emerging, including the highly transmissible Delta variant and the newly discovered Omicron variant (currently a "variant of concern"), spreading throughout the United States and globally and causing significant uncertainty.

The COVID-19 outbreak materially and adversely affected our business operations and financial condition due to the pandemic causing a deteriorating market outlook, global economic recession and weakened company liquidity. Although demand for coal and coal prices has recovered from the lows of 2020 through the second quarter of 2021, these conditions caused or exacerbated by the pandemic may lead to continued volatility of coal prices, severely limited liquidity and credit availability and declining valuations of assets, which have adversely affected, and will continue to affect, our business, financial condition, liquidity and results of operations.

In addition, the COVID-19 pandemic, and measures taken by governments, organizations, the Company and our customers to reduce its effects could potentially impact our employees, customers and suppliers. The global or national outbreak of an illness or other communicable disease, or any other public health crisis, such as COVID-19, may cause disruptions to our business and operational plans, which may include: (i) shortages of employees, (ii) unavailability of contractors or subcontractors, (iii) interruption of supplies from third parties upon which we rely, (iv) reliability and cost of transportation, (v) changes in purchasing patterns of our customers and their effects on our coal supply agreements; and (vi) recommendations of, or restrictions imposed by, government and health authorities,

including quarantines, to address an outbreak. For example, at the beginning 2022, we experienced issues in the logistics chain that delayed our ability to load coal onto vessels.

Additionally, in the event that customers, contractors, employees or others were to allege that they contracted COVID-19, or otherwise suffered compensable losses arising out of a COVID-19 exposure or infection, because of actions we took or failed to take, we could face claims, lawsuits and potential legal liability. In addition to the reasonableness of our actions and efforts to comply with applicable COVID-19 guidance, our exposure and ultimate liability would depend upon the relationship between us and the person asserting claims, the nature of the claims asserted, the applicability of workers' compensation, the availability of other insurance coverage and limitations on liability currently being considered, if enacted, at the state and federal level. Such disruptions and risks may continue or increase in the future, and could adversely affect, our business, financial condition, liquidity and results of operations.

The full extent to which the COVID-19 pandemic will impact our results is not fully known and is evolving, and will depend on future developments, which are highly uncertain and cannot be predicted. These include the severity, duration and spread of COVID-19, the success of actions taken by governments and health organizations to combat the disease and treat its effects, including additional remedial legislation, the emergence of any new COVID-19 variants that may arise, the timing, availability, effectiveness and adoption rates of vaccines and treatments and the extent to which, and when, general economic and operating conditions recover. Accordingly, any resulting financial impact cannot be reasonably estimated at this time but such amounts may be material.

Risks Related to Our Operations and Industry

Coal prices are subject to change based on a number of factors and can be volatile. If there is a decline in prices, it could materially and adversely affect our profitability and the value of our coal reserves.

Our profitability and the value of our coal reserves depend upon the prices we receive for our coal. The contract prices we may receive in the future for coal depend upon factors beyond our control, including the following:

- the domestic and foreign supply of and demand for coal;
- the domestic and foreign demand for steel and electricity;
- competition for production of steel from non-coal sources including, electric arc furnaces, which may limit demand for coking coal;
- the quantity and quality of coal available from competitors;
- competition for production of electricity from non-coal sources, including the price and availability of alternative fuels;
- domestic and foreign air emission standards for coal-fueled power plants and blast furnaces and the ability to meet these standards;
- adverse weather, climatic or other natural conditions, including unseasonable weather patterns;
- domestic and foreign economic conditions, including economic slowdowns and the exchange rates of U.S. dollars for foreign currencies;
- domestic and foreign legislative, regulatory and judicial developments, environmental regulatory changes or changes in energy policy and energy conservation measures that could adversely affect the coal industry, such as legislation limiting carbon emissions or providing for increased funding and incentives for alternative energy sources;
- the imposition of tariffs, quotas, trade barriers and other trade protection measures;
- the proximity to, capacity of, and cost of transportation and port facilities; and
- technological advancements, including those related to hydrogen based steel production alternative energy sources, those intended to convert coal-to-liquids or gas.

Declines in the prices we receive for our future coal sales contracts, could materially and adversely affect us by decreasing our profitability, cash flows, liquidity and the value of our coal reserves.

Volatile economic and market conditions have affected and in the future may continue to affect our revenues and profitability.

Global economic downturns have negatively impacted, and in the future could negatively impact, our revenues and profitability. Our profitability depends, in large part, on conditions in the markets that we serve, which fluctuate in response to various factors beyond our control. The prices at which we sell our coal are largely dependent on prevailing market prices. We have experienced significant price volatility at times during the past several years.

The conditions surrounding the COVID-19 pandemic have led to extreme volatility of prices. If there are further downturns in economic conditions, our and our customers' businesses, financial condition and results of operations could be adversely affected. There can be no assurance that our cost control actions and capital discipline, or any other actions that we may take, will be sufficient to offset any adverse effect these conditions may have on our business, financial condition or results of operations.

Our coal mining operations are subject to operating risks that are beyond our control, which could result in materially increased operating expenses and decreased production levels and could materially and adversely affect our profitability.

We conduct underground and surface mining operations. Certain factors beyond our control, including those listed below, could disrupt our coal mining operations, adversely affect production and shipments and increase our operating costs:

- poor mining conditions resulting from geological, hydrologic or other conditions that may cause instability of highwalls or spoil piles or cause damage to nearby infrastructure or mine personnel;
- a major incident at the mine site that causes all or part of the operations of the mine to cease for some period of time;
- mining, processing and plant equipment failures and unexpected maintenance problems;
- adverse weather and natural disasters, such as heavy rains or snow, flooding and other natural events affecting operations, transportation or customers, and public health crises, such as the COVID-19 pandemic;
- the unavailability of raw materials, equipment (including heavy mobile equipment) or other critical supplies such as tires, explosives, fuel, lubricants and other consumables of the type, quantity and/or size needed to meet production expectations;
- unexpected or accidental surface subsidence from underground mining;
- accidental mine water discharges, fires, explosions or similar mining accidents;
- delays, closures, or labor unavailability by third parties that transport coal shipments; and
- competition and/or conflicts with other natural resource extraction activities and production within our operating areas, such as coalbed methane extraction or oil and gas development.

If any of these conditions or events occurs, our coal mining operations may be disrupted and we could experience a delay or halt of production or shipments or our operating costs could increase significantly. In addition, if our insurance coverage is limited or excludes certain of these conditions or events, then we may not be able to recover, or recover fully, for losses incurred as a result of such conditions or events, some of which may be substantial.

The loss of availability, reliability and cost-effectiveness of transportation facilities and fluctuations in transportation costs could affect the demand for our coal or impair our ability to supply coal to our customers.

We depend upon barge, ship, rail, truck and belt transportation systems, as well as seaborne vessels and port facilities, to deliver coal to our customers. Disruptions in transportation services due to weather-related problems, mechanical difficulties, labor shortages, strikes, lockouts, bottlenecks, route closures, natural disasters and health crises, such as the COVID-19 pandemic, and other events beyond our control could impair our ability to supply coal to our customers. Since we do not have long-term contracts with all transportation providers we utilize, decreased performance levels over longer periods of time could cause our customers to look to other sources for their coal needs. In addition, increases in transportation costs, including the price of gasoline and diesel fuel, could make coal a less competitive source

of energy when compared to alternative fuels or could make coal produced in one region of the United States less competitive than coal produced in other regions of the United States or abroad.

If we experience disruptions in our transportation services or if transportation costs increase significantly and we are unable to find alternative transportation providers, our coal mining operations may be disrupted, we could experience a delay or halt of production or our profitability could decrease significantly. In addition, a growing portion of our coal sales in recent years has been into export markets, and we are actively seeking additional international customers. Our ability to maintain and grow our export sales revenue and margins depends on a number of factors, including the existence of sufficient and cost-effective export terminal capacity for the shipment of coal to foreign markets. At present, there is limited terminal capacity for the export of coal into foreign markets. Our access to existing and future terminal capacity may be adversely affected by, among other factors, regulatory and permit requirements, environmental and other legal challenges, public perceptions and resulting political pressures, foreign and domestic trade policies, operational issues at terminals and competition among domestic coal producers for access to limited terminal capacity. If we are unable to maintain terminal capacity, or are unable to access additional future terminal capacity for the export of our coal on commercially reasonable terms, or at all, our results could be materially and adversely affected.

From time to time we enter into “take or pay” contracts for rail and port capacity related to our export sales. These contracts require us to pay for a minimum quantity of coal to be transported on the railway or through the port, regardless of whether we sell and ship any coal. If we fail to acquire sufficient export sales to meet our minimum obligations under these contracts, we are still obligated to make payments to the railway or port facility, which could have a negative impact on our cash flows, profitability and results of operations.

Inflationary pressures for mining and other industrial supplies, including steel-based supplies, diesel fuel and rubber tires, or the inability to obtain a sufficient quantity of those supplies, could negatively affect our operating costs or disrupt or delay our production.

Our coal mining operations use significant amounts of steel, diesel fuel, explosives, rubber tires and other mining and industrial supplies. The cost of roof bolts we use in our underground mining operations depends on the price of scrap steel. We also use significant amounts of diesel fuel and tires for trucks and other heavy machinery, particularly at our Black Thunder mining complex. There has been some consolidation in the supplier base providing mining materials to the coal industry, such as suppliers of explosives in the U.S. and suppliers of both surface and underground equipment globally, which has limited the number of sources for these materials. If the prices of mining and other industrial supplies, particularly steel based supplies, diesel fuel and rubber tires, increase, due to inflationary pressures or for other reasons, our operating costs could increase. In addition, if we are unable to procure these supplies, our coal mining operations may be disrupted or we could experience a delay or halt in our production. Any of the foregoing events could materially and adversely impact our business, financial condition, results of operations and cash flows.

The effects of foreign and domestic trade policies, actions or disputes on the level of trade among the countries and regions in which we operate could negatively impact our business, financial condition or results of operations.

Trade barriers such as tariffs imposed by the United States could potentially lead to trade disputes with other foreign governments and adversely impact global economic conditions. For instance, as a result of a near term ban on Australian coal exports to China, traders and buyers have diverted cargoes into other markets around the world, including India and Europe which has disrupted the traditional trading routes for metallurgical coal. Further, in March 2018, the United States imposed a 25% tariff on all imported steel into the United States citing national security interests, which resulted in certain foreign countries imposing offsetting tariffs in retaliation. In December 2021, the Biden Administration revised the 25% tariff with the European Union to a tariff-rate quota on imports greater than a certain tonnage amount, and continued the original Section 232 tariffs, under the Trade Expansion Act of 1962, as amended, with respect to all other importers of steel into the United States. Continued or worsening United States-China trade tensions may result in additional tariffs or other protectionist measures that could materially, adversely affect foreign demand for our coal.

In addition, potential changes to international trade agreements, trade policies, trade concessions or other political and economic arrangements may benefit coal producers operating in countries other than the United States. We may not be able to compete on the basis of price or other factors with companies that, in the future, benefit from favorable foreign trade policies or other arrangements.

Competition, including with respect to transportation, could put downward pressure on coal prices and, as a result, materially and adversely affect our revenues and profitability.

We compete with numerous other domestic and foreign coal producers for domestic and international sales. Overcapacity and increased production within the coal industry, both domestically and internationally, and decelerating steel demand have at times, and could in the future, materially reduce coal prices and therefore materially reduce our revenues and profitability. In addition, our ability to ship our coal to international customers depends on port capacity, which is limited, and has come under heightened pressure recently, as a consequence of the COVID-19 pandemic. Increased competition within the coal industry for international sales could result in us not being able to obtain throughput capacity at port facilities, or the rates for such throughput capacity could increase to a point where it is not economically feasible to export our coal.

In addition to competing with other coal producers, we compete with producers of other fuels, such as natural gas and subsidized renewables. Despite the recent uptick, natural gas pricing has declined significantly in recent years and has historically been the main basis for setting the price of our domestic thermal product. Declines in the price of natural gas have caused demand for coal to decrease and have adversely affected the price of our coal. Historical sustained periods of low natural gas prices have also contributed to utilities phasing out or closing existing coal-fired power plants, and a return to low prices could eliminate construction of any new coal-fired power plants. This trend has, and could continue to have, a material adverse effect on demand and prices for our coal. Moreover, the construction of new pipelines and other natural gas distribution channels may increase competition within regional markets and thereby decrease the demand for and price of our coal.

Our customers are continually evaluating alternative steel production technologies, which may reduce demand for our product.

Our metallurgical coal is a premium High-Vol metallurgical coal for blast furnace steel producers. Premium High-Vol metallurgical coal commands a significant price premium over other forms of coal because of its value in use in blast furnaces for steel production. Premium High-Vol metallurgical coal is a scarce commodity and has specific physical and chemical properties which are necessary for efficient blast furnace operation. Alternative technologies are continually being investigated and developed with a view to reducing production costs or for other reasons, such as minimizing environmental or social impact. If competitive technologies emerge or are increasingly utilized that use other materials in place of our product or that diminish the required amount of our product, such as electric arc furnaces or pulverized coal injection processes, demand and price for our metallurgical coal might fall. Many of these alternative technologies are designed to use lower quality coals or other sources of carbon instead of higher cost High-Vol metallurgical coal. While conventional blast furnace technology has been the most economic large-scale steel production technology for several years, and while emergent technologies typically take many years to commercialize, there can be no assurance that, over the longer -term, competitive technologies not reliant on High-Vol metallurgical coal could emerge which could reduce demand and price premiums for High-Vol metallurgical coal.

Our ability to operate our business effectively could be impaired if we lose key personnel or fail to attract qualified personnel.

We manage our business with a number of key personnel, the loss of whom could have a material adverse effect on us, absent the completion of an orderly transition. Efficient mining using modern techniques and equipment requires skilled laborers with mining experience and proficiency as well as qualified managers and supervisors. The demand for skilled employees sometimes causes a significant constriction of the labor supply resulting in higher labor costs. When coal producers compete for skilled miners, recruiting challenges can occur and employee turnover rates can increase, which negatively affect operating efficiency and costs. If a shortage of skilled workers exists and we are unable to train

or retain the necessary number of miners, it could adversely affect our productivity, costs and ability to expand production.

Our profitability depends upon the coal supply agreements we have with our customers. Changes in purchasing patterns in the coal industry could make it difficult for us to extend our existing coal supply agreements or to enter into new agreements in the future.

The success of our businesses depends on our ability to retain our current customers, renew our existing customer contracts and solicit new customers. Our ability to do so generally depends on a variety of factors, including the quality and price of our products, our ability to market these products effectively, our ability to deliver on a timely basis and the level of competition that we face. If current customers do not honor current contract commitments, or if they terminate agreements or exercise *force majeure* provisions allowing for the temporary suspension of their performance, our revenues will be adversely affected. Changes in the coal industry may cause some of our customers not to renew, extend or enter into new coal supply agreements or to enter into agreements to purchase fewer tons of coal or on different terms or prices than in the past. In addition, uncertainty caused by federal and state regulations, including under the U.S. Clean Air Act, could deter our customers from entering into coal supply agreements. Also, the availability and price of competing fuels, such as natural gas, could influence the volume of coal a customer is willing to purchase under contract.

Our coal supply agreements typically contain *force majeure* provisions allowing the parties to temporarily suspend performance during specified events beyond their control. Most of our coal supply agreements also contain provisions requiring us to deliver coal that satisfies certain quality specifications, such as heat value, sulfur content, ash content, volatile matter, hardness and ash fusion temperature, among others. These provisions in our coal supply agreements could result in negative economic consequences to us, including price adjustments, having to purchase replacement coal in a higher-priced open market, the rejection of deliveries or, in the extreme, contract termination. Our profitability may be negatively affected if we are unable to seek protection during adverse economic conditions or if we incur financial or other economic penalties as a result of these provisions of our coal supply agreements. For more information about our long-term coal supply agreements, you should see the section entitled “Long-Term Coal Supply Arrangements” under Item 1.

The loss of, or a significant reduction in, purchases by our largest customers could adversely affect our profitability.

For the year ended December 31, 2021, we derived approximately 20% of our total coal revenues from sales to our three largest customers and approximately 49% of our total coal revenues from sales to our ten largest customers. If any of those customers, particularly any of our three largest customers, were to significantly reduce the quantities of coal it purchases from us, or if we are unable to sell coal to those customers on terms as favorable to us, it may have an adverse impact on the results of our business.

Disruptions in the quantities of coal purchased from other third parties could temporarily impair our ability to fill customer orders or increase our operating costs.

We purchase coal from third parties that we sell to our customers. Operational difficulties at mines operated by third parties from whom we purchase coal, changes in demand from other coal producers and other factors beyond our control could affect the availability, pricing, and quality of coal purchased by us. Disruptions in the quantities of coal purchased by us could impair our ability to fill our customer orders or require us to purchase coal from other sources in order to satisfy those orders. If we are unable to fill a customer order or if we are required to purchase coal from other sources at higher prices and / or lower quality, in order to satisfy a customer order, we could lose existing customers and our operating costs could increase.

International growth in our sales adds new and unique risks to our business.

We have sales offices in Singapore and the United Kingdom. In addition, our international offices sell our coal to new customers and customers in new countries, which may present uncertainties and new risks. A majority of our

metallurgical coal sales consist of sales to international customers, and we expect that international sales will continue to account for a larger portion of our revenue. A number of foreign countries in which we sell our metallurgical coal implicate additional risks and uncertainties due to the different economic, cultural and political environments. Such risks and uncertainties include, but are not limited to:

- longer sales-cycles and time to collection;
- tariffs and international trade barriers and export license requirements, including any that might result from the current global trade uncertainties;
- different and changing legal and regulatory requirements;
- potential liability under the U.S. Foreign Corrupt Practices Act of 1977, as amended, or comparable foreign regulations;
- government currency controls;
- fluctuations in foreign currency exchange and interest rates;
- political and economic instability, changes, hostilities and other disruptions (including as a result of the COVID-19 pandemic); and
- unexpected changes in diplomatic and trade relationships.

Negative developments in any of these factors in the foreign markets into which we sell our metallurgical coal could result in a reduction in demand for metallurgical coal, the cancellation or delay of orders already placed, difficulty in collecting receivables, higher costs of doing business and/or non-compliance with legal and regulatory requirements, each or any of which could materially adversely impact our cash flows, results of operations and profitability.

Our ability to collect payments from our customers could be impaired if their creditworthiness deteriorates, and our financial position could be materially and adversely affected by the bankruptcy of any of our significant customers.

Our ability to receive payment for coal sold and delivered depends on the continued creditworthiness of our customers. If we determine that a customer is not creditworthy, we may be able to withhold delivery under the customer's coal sales contract. If this occurs, we may decide to sell the customer's coal on the spot market, which may be at prices lower than the contracted price, or we may be unable to sell the coal at all. Furthermore, the bankruptcy of any of our significant customers could materially and adversely affect our financial position.

In addition, our customer base may change with deregulation as utilities sell their power plants to their non-regulated affiliates or third parties that may be less creditworthy, thereby increasing the risk we bear for customer payment default. Some power plant owners may have credit ratings that are below investment grade, or may become below investment grade after we enter into contracts with them. Furthermore, our metallurgical customers operate in a highly competitive and cyclical industry where their creditworthiness could deteriorate rapidly. In addition, competition with other coal suppliers could force us to extend credit to customers and on terms that could increase the risk of payment default. Customers in other countries may also be subject to other pressures and uncertainties that may affect their ability to pay, including trade barriers, exchange controls and local economic and political conditions.

Failure to obtain or renew surety bonds on acceptable terms could affect our ability to secure reclamation and coal lease obligations and, therefore, our ability to mine or lease coal.

Federal and state laws require us to obtain surety bonds or post other financial security to secure performance or payment of certain long-term obligations, such as mine closure or reclamation costs, federal and state workers' compensation and black lung benefits costs, coal leases and other obligations. The amount of security required to be obtained can change as the result of new federal or state laws, as well as changes to the factors used to calculate the bonding or security amounts. We may have difficulty procuring or maintaining our surety bonds. Our bond issuers may demand higher fees or additional collateral, including letters of credit or other terms less favorable to us upon those renewals.

Because we are required by state and federal law to have these surety bonds or other acceptable security in place before mining can commence or continue, our failure to maintain surety bonds, letters of credit or other guarantees or security arrangements would materially and adversely affect our ability to mine or lease metallurgical coal. That failure could result from a variety of factors, including lack of availability, higher expense or unfavorable market terms, the exercise by third-party surety bond issuers of their right to refuse to renew the sureties and restrictions on availability of collateral for current and future third-party surety bond issuers under the terms of our financing arrangements.

As of December 31, 2021, we had approximately $584.1 million in surety bonds backed by $87.0 million of letters of credit outstanding. Any further issuances of letters of credit to satisfy the increased collateral demands or any replacement surety bonds would immediately reduce the borrowing capacity under our credit facilities. At December 31, 2021, the Company established a fund for asset retirement obligations and thus far has contributed $20 million that will serve to defease the long-term asset retirement obligation for its thermal asset base.

Inaccuracies in our estimates of our coal reserves could result in decreased profitability from lower than expected revenues or higher than expected costs.

Our future performance depends on, among other things, the accuracy of our estimates of our proven and probable coal reserves. We base our estimates of reserves on engineering, economic and geological data assembled, analyzed and reviewed by internal and third-party engineers and consultants. We update our estimates of the quantity and quality of proven and probable coal reserves annually to reflect the production of coal from the reserves, updated geological models and mining recovery data, the tonnage contained in new lease areas acquired and estimated costs of production and sales prices. There are numerous factors and assumptions inherent in estimating the quantities and qualities of, and costs to mine, coal reserves, including many factors beyond our control, including the following:

- quality of the coal;
- geological and mining conditions, which may not be fully identified by available exploration data and / or may differ from our experiences in areas where we currently mine;
- the percentage of coal ultimately recoverable;
- the assumed effects of regulation, including the issuance of required permits, taxes, including severance and excise taxes, and royalties, and other payments to governmental agencies;
- assumptions concerning the timing for the development of the reserves;
- assumptions concerning physical access to the reserves; and
- assumptions concerning equipment and productivity, future coal prices, operating costs, including for critical supplies such as fuel, tires and explosives, capital expenditures and development and reclamation costs.

As a result, estimates of the quantities and qualities of economically recoverable coal attributable to any particular group of properties, classifications of reserves based on risk of recovery, estimated cost of production and estimates of future net cash flows expected from these properties, as prepared by different engineers, or by the same engineers at different times, may vary materially due to changes in the above factors and assumptions. Actual production recovered from identified reserve areas and properties, and revenues and expenditures associated with our mining operations, may vary materially from estimates. Any inaccuracy in our estimates related to our reserves could result in decreased profitability from lower than expected revenues and/or higher than expected costs.

A defect in title or the loss of a leasehold interest in certain properties or surface rights could limit our ability to mine our coal reserves or result in significant unanticipated costs.

We conduct a significant part of our coal mining operations on properties that we lease. A title defect or the loss of a lease or surface rights could adversely affect our ability to mine the associated coal reserves. We may not verify title to our leased properties or associated coal reserves until we have committed to developing those properties or coal reserves. We may not commit to develop properties or coal reserves until we have obtained necessary permits and completed exploration. As such, the title to properties that we intend to lease or coal reserves that we intend to

mine may contain defects prohibiting our ability to conduct mining operations. Similarly, our leasehold interests may be subject to superior property rights of other third parties. In order to conduct our mining operations on properties where these defects exist, we may incur unanticipated costs. In addition, some leases require us to produce a minimum quantity of coal and require us to pay minimum production royalties. Our inability to satisfy those requirements may cause the leasehold interest to terminate, which could negatively impact our business, financial condition, results of operations and cash flows.

We may incur losses as a result of certain marketing and asset optimization strategies.

We seek to optimize our coal production and leverage our knowledge of the coal industry through a variety of marketing and asset optimization strategies. We maintain a system of complementary processes and controls designed to monitor and control our exposure to market and other risks as a consequence of these strategies. These processes and controls seek to balance our ability to profit from certain marketing and asset optimization strategies against our exposure to potential losses. Our risk monitoring and mitigation techniques, and accompanying judgments cannot anticipate every potential outcome or the timing of such outcomes. In addition, the processes and controls that we use to manage our exposure to market and other risks resulting from these strategies involve assumptions about the degrees of correlation or lack thereof among prices of various assets or other market indicators. These correlations may change significantly in times of market turbulence or other unforeseen circumstances. As a result, we may experience volatility in our earnings as a result of our marketing and asset optimization strategies.

Any decrease in the coal consumption of electric power generators could result in less demand and lower prices for thermal coal, which could materially and adversely affect our revenues and results of operations.

Thermal coal accounted for 91% of our coal sales by volume and 56% of the coal sales revenue during 2021. The majority of these sales were to electric power generators. The amount of coal consumed for electric power generation is affected primarily by the overall demand for electricity, the availability, quality and price of competing fuels (particularly natural gas) for power generation and governmental regulations which may dictate an alternate source of fuel regardless of economics. Overall economic activity and the associated demand for power by industrial users can have significant effects on overall electricity demand and can be impacted by a number of factors. An economic slowdown can significantly slow the growth of electricity demand and could result in reduced demand for coal. Weather patterns also greatly affect electricity demand. Extreme temperatures, both hot and cold, cause increased power usage and, therefore, increase generating requirements from all sources. Mild temperatures, on the other hand, result in lower electrical demand, which allows generators to choose the source of power generation that is most cost efficient.

Gas-fueled generation has the potential to displace coal-fueled generation, particularly from older, less efficient coal-powered generators and this has occurred to date. We expect that all of the new power plants constructed in the United States, to meet increasing demand for electricity generation, will be fueled by natural gas because gas-fired plants are cheaper to construct and permits to construct these plants are easier to obtain as natural gas combustion is seen as having a lower environmental impact than coal combustion. In addition, state and federal mandates for increased use of electricity from renewable energy sources also have an impact on the market for our coal. Several states have enacted legislative mandates requiring electricity suppliers to use renewable energy sources to generate a certain percentage of power. There have been numerous proposals to establish a similar uniform national standard, although none of these proposals have been enacted to date. The costs of certain renewable energy sources have become increasingly competitive to coal, and possible advances in technologies and incentives, such as tax credits, to enhance the economics of renewable energy sources, could make these sources even more competitive. Any reduction in the amount of coal consumed by electric power generators could reduce the price of coal that we mine and sell, thereby reducing our revenues and materially and adversely affecting our business and results of operations.

If we or our service providers sustain cyber-attacks or other security incidents that involve unauthorized access to proprietary, confidential or personally identifiable information, or disruptions, we could be exposed to significant liability, reputational harm, loss of revenue, increased costs and material risks to our business and results.

We have become increasingly dependent on information technology systems to operate our business and to comply with regulatory, legal and tax requirements. Some of these systems are owned and operated by us and others by our third-party services providers. In addition, in the ordinary course of our business, we and our service providers collect, process, transmit and store data, such as proprietary business information and personally identifiable information.

As our dependence on digital technologies has increased, the risk of cyber incidents, including both deliberate attacks and unintentional events, also has increased. A cyber-attack may involve persons gaining unauthorized access to our digital systems or systems maintained on our behalf for purposes of gathering, monitoring, releasing, misappropriating or corrupting proprietary or confidential or personal information, or causing operational disruption. In addition, certain cyber incidents, such as surveillance, may remain undetected for an extended period of time. Strategic targets, such as energy-related assets, may be at greater risk of future cyber-attacks than other targets in the United States.

We and certain of our service providers have, from time to time, been subject to cyberattacks and security incidents. To date, we have not experienced any material losses relating to cyber incidents. However, our systems may be susceptible to cyber incidents or security breaches and both the frequency and magnitude of cyberattacks is expected to increase and attackers are becoming more sophisticated. As a result, we may be unable to anticipate, detect or prevent future attacks, particularly as the methodologies utilized by attackers change frequently or are not recognized until launched, and we may be unable to investigate or remediate incidents because attackers are increasingly using techniques and tools designed to circumvent controls, to avoid detection, and to remove or obfuscate forensic evidence.

While we and our service providers have implemented various controls and measures, cyberattacks and other security incidents could result in unauthorized access to our facilities or to information we are trying to protect, or to significant operational or supply chain disruptions (for example, due to DDOS or ransomware attacks). Failure of our or our service providers' systems, whether caused maliciously or inadvertently, may lead to unauthorized physical access to one or more of our facilities or locations, or electronic access to, or corruption or destruction or loss of, proprietary, confidential, or personally identifiable information and could result in, among other things, unfavorable publicity and reputational damage, litigation, disruptions to our operations, loss of customers and financial obligations that may not be covered by our insurance for damages, regulatory investigations and enforcement, fines or penalties related to the theft, release or misuse of information, any or all of which could have a material adverse impact on our results of operations, financial condition or cash flow. In addition, as cyber threats continue to evolve, we may be required to expend significant additional resources to modify or enhance our protective measures or to investigate and remediate any system vulnerabilities. This is particularly the case given fast evolving legislative and regulatory changes to data privacy and data security laws globally. Any losses, costs or liabilities directly or indirectly related to cyberattacks or similar incidents may not be covered by, or may exceed the coverage limits of, any or all of our applicable insurance policies.

Our inability to acquire additional coal reserves or our inability to develop coal reserves in an economically feasible manner may adversely affect our business.

Our profitability depends substantially on our ability to mine and process, in a cost-effective manner, coal reserves that possess the quality characteristics desired by our customers. As we mine, our coal reserves deplete. As a result, our future success depends upon our ability to obtain, through acquisition or development of owned reserves, coal that is economically recoverable. If we fail to acquire or develop additional coal reserves, our existing reserves will eventually be depleted. We may not be able to obtain replacement reserves when we require them. Even if available, replacement reserves may not be available at favorable prices, or we may not be capable of mining those reserves at costs that are comparable with our existing coal reserves. In certain locations, leases for oil, natural gas and coalbed methane reserves are located on, or adjacent to, some of our reserves, potentially creating conflicting interests between us and lessees of those interests. Other lessees' rights relating to these mineral interests could prevent, delay or increase the cost of

developing our coal reserves. These lessees may also seek damages from us based on claims that our coal mining operations impair their interests.

Our ability to obtain coal reserves in the future could also be limited by the availability of cash we generate from our operations or available financing, restrictions under our existing or future financing arrangements, competition from other coal producers, limited opportunities or the inability to acquire coal properties on commercially reasonable terms. Increased opposition from non-governmental organizations and other third parties may also lengthen, delay or adversely impact the acquisition process. If we are unable to acquire replacement reserves, our future production may decrease significantly and our operating results may be negatively affected. In addition, we may not be able to mine future reserves as profitably as we do at our current operations.

We may be unable to comply with the restrictions imposed by our Term Loan Debt Facility and other financing arrangements.

The agreements governing our outstanding financing arrangements impose a number of restrictions on us. For example, the terms of our credit facilities, leases and other financing arrangements contain financial and other covenants that may create limitations on our ability to borrow the full amount under our credit facilities, effect acquisitions or dispositions and incur additional debt and require us to comply with various affirmative covenants. The Term Loan Debt Facility contains customary affirmative and negative covenants, which include restrictions on (i) indebtedness, (ii) liens, (iii) liquidations, mergers, consolidations and acquisitions, (iv) disposition of assets or subsidiaries, (v) affiliate transactions, (vi) creation or ownership of certain subsidiaries, partnerships and joint ventures, (vii) continuation of or change in business, (viii) restricted payments, (ix) prepayment of subordinated and junior lien indebtedness, (x) restrictions in agreements on dividends, intercompany loans and granting liens on collateral, (xi) loans and investments, (xii) sale and leaseback transactions, (xiii) changes in organizational documents and fiscal year and (xiv) transactions with respect to bonding subsidiaries. Our ability to comply with these provisions may be affected by events beyond our control and our failure to comply could result in an event of default under the Term Loan Debt Facility.

We may be unable to raise the funds necessary to repurchase our Convertible Notes for cash following a fundamental change, or to pay any cash amounts due upon conversion, and our other indebtedness limits our ability to repurchase the notes or pay cash upon their conversion.

Convertible noteholders may, subject to a limited exception, require us to repurchase their notes following a fundamental change (including certain delisting events that we elect to treat as the occurrence of a fundamental change), at a cash repurchase price generally equal to the principal amount of the notes to be repurchased, plus accrued and unpaid interest, if any. In addition, upon conversion we will satisfy part or all of our conversion obligation in cash unless we elect to settle conversions solely in shares of our common stock. We may not have enough available cash or be able to obtain financing at the time we are required to repurchase the notes or pay the cash amounts due upon conversion. In addition, applicable law, regulatory authorities and the agreements governing our other indebtedness may restrict our ability to repurchase the notes or pay the cash amounts due upon conversion. Our failure to repurchase notes or to pay the cash amounts due upon conversion when required would constitute a default under the indenture governing the Convertible Notes. A default under the indenture or the fundamental change itself could also lead to a default under agreements governing our other indebtedness, and may result in that other indebtedness becoming immediately payable in full. We may not have sufficient funds to satisfy all amounts due under the other indebtedness and the notes.

Risks Related to Environmental, Other Regulations and Legislation

Extensive environmental regulations, including existing and potential future regulatory requirements relating to air emissions, affect our customers and could reduce the demand for coal as a fuel source and cause coal prices and sales of our coal to materially decline.

Coal contains impurities, including but not limited to sulfur, mercury, chlorine and other elements or compounds, many of which are released into the air when coal is burned. The operations of our customers are subject to extensive environmental regulation particularly with respect to air emissions. For example, the federal Clean Air Act and similar state and local laws extensively regulate the amount of sulfur dioxide, particulate matter, nitrogen oxide, and other compounds emitted into the air from electric power plants, which are the largest end-users of our coal. A series of more stringent requirements relating to particulate matter, ozone, haze, mercury, sulfur dioxide, nitrogen oxide and other air pollutants may be developed and implemented. For instance, the Clean Power Plan, if implemented in the form promulgated under the Obama administration, would severely limit emissions of carbon dioxide which would adversely affect our ability to sell coal. However, in April 2017, the EPA announced that it was initiating a review of the Clean Power Plan consistent with President Trump's Executive Order 13783, and, in October 2017, the EPA published a proposed rule to formally repeal the Clean Power Plan. In June 2019, the EPA issued the final Affordable Clean Energy rule, which revised the agency's interpretation of Clean Air Act section 111(d). In January 2021, the D.C. Circuit Court of Appeals vacated the Affordable Clean Energy rule and its implied repeal of the Clean Power Plan, remanding to the EPA for further proceedings. The Supreme Court agreed to hear the case in October 2021. Oral argument is scheduled for February 2022 and a decision is expected by late June or early July 2022. It is not clear whether the EPA will reinstate the Clean Power Plan or undertake new rulemaking.

In addition, the change in presidential administration has resulted in a further shift in policy by the EPA. As explained above, in December 2015, the United States and 195 other countries reached an agreement (the "Paris Agreement") during the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change, a long-term, international framework convention designed to address climate change over the next several decades. The Trump administration formally withdrew the United States from the Paris Agreement, effective November 2020. However, President Biden has recommitted the United States to the Paris Agreement and, in April 2021, announced a goal of reducing the United States' emissions by 50-52% below 2005 levels by 2030. In November 2021, the international community gathered again in Glasgow at the 26th Conference to the Parties on the UN Framework Convention on Climate Change ("COP26"), during which multiple announcements were made, including a call for parties to eliminate certain fossil fuel subsidies and pursue further action on non-CO2 greenhouse gasses. Relatedly, the United States and European Union jointly announced the launch of the "Global Methane Pledge," which aims to cut global methane pollution at least 30% by 2030 relative to 2020 levels, including "all feasible reductions" in the energy sector. President Biden also agreed that same month to cooperate with Chinese leader Xi Jinping on accelerating progress toward the adoption of clean energy. The impacts of these orders, pledges, agreements and any legislation or regulation promulgated to fulfill the United States' commitments under the Paris Agreement, COP26, or other international conventions cannot be predicted at this time. However, any efforts to control and/or reduce greenhouse gas emissions by the United States or other countries that have also pledged "Nationally Determined Contributions," or concerted conservation efforts that result in reduced electricity consumption, could adversely impact coal prices, our ability to sell coal and, in turn, our financial position and results of operations.

In addition, a January 21, 2021 executive order from the Biden administration directed all federal agencies to review and take action to address any federal regulations, orders, guidance documents, policies and any similar agency actions promulgated during the prior administration that may be inconsistent with the administration's policies. The executive order also established an Interagency Working Group on the Social Cost of Greenhouse Gases ("Working Group"), which is called on to, among other things, develop methodologies for calculating the "social cost of carbon," "social cost of nitrous oxide" and "social cost of methane." Final recommendations from the Working Group are due no later than January 2022. The Biden administration issued another executive order on January 27, 2021, that was specifically focused on addressing climate change. Further regulation of air emissions at the federal level, as well as

uncertainty regarding the future course of federal regulation, could reduce demand for coal and negatively impact our financial position and results of operations.

In March 2021, the Biden Administration announced a framework for the "Build Back Better" agenda. The proposed framework included policies to address climate change across the federal government through the tax code, an energy efficiency and clean energy standard, and research and development, among other areas of focus. Relatedly, the U.S. House Energy and Commerce Committee released, and has been holding hearings on, the Climate Leadership and Environmental Action for our Nation's ("CLEAN") Future Act, which is expected to influence legislation furthering the "Build Back Better" agenda. The CLEAN Future Act proposes, among other things, a clean electricity standard that would require electricity suppliers to procure and retire clean energy credits offsetting, in the aggregate, 80% of the energy sold by 2030 and 100% by 2035. It would establish an auction-based mechanism for these credits and award partial credits to certain types of carbon-emitting generation that have lower-than-average emissions rates.

"Build Back Better" has been on two tracks in Congress, with a bipartisan "infrastructure" bill that has passed in the Senate and House of Representatives and was signed into law on November 15, 2021, which includes climate provisions focused on transportation and resiliency and an expected multi-trillion-dollar budget social spending bill that is being advanced under the reconciliation process to address additional priorities, including the climate impacts of energy production. A Clean Electricity Standard, or similar program, remains a goal of the Biden Administration, despite an unclear political path forward. The reconciliation bill may also include energy tax credits, which are expected to incentivize producers and purchasers of certain forms of energy, such as solar, wind, and nuclear, but not other forms of energy production. Although the social spending bill and Clean Electricity Standard proposals have not yet resulted in any new legislation being enacted or regulations promulgated, we are closely monitoring both legislative and executive agency action.

We are also subject to state and local regulations, which may be more stringent than federal rules. For example, certain United States cities and states have announced their intention to satisfy their proportionate obligations under the Paris Agreement. In addition, almost one-half of states have taken measures to track and reduce emissions of greenhouse gases, and some states have elected to participate in voluntary regional cap-and-trade programs like the Regional Greenhouse Gas Initiative in the northeastern United States. State and local governments may pass laws mandating the use of alternative energy sources, such as wind power and solar energy, which may decrease demand for our coal products. State and local commitments and regulations could have a material adverse effect on our business, financial condition and results of operations.

Considerable uncertainty is associated with these air emissions initiatives, and the content of regulatory requirements in the United States and other countries continues to evolve and develop, which could require significant emissions control expenditures for many coal-fueled power plants. As a result, these power plants may switch to other fuels that generate fewer of these emissions, may install more effective pollution control equipment that reduces the need for low sulfur coal, or may cease operations, possibly reducing future demand for coal and a reduced need to construct new coal-fueled power plants. Any switching of fuel sources away from coal, closure of existing coal-fired plants or reduced construction of new plants could have a material adverse effect on demand for, and prices received for, our coal. Alternatively, less stringent air emissions limitations, particularly related to sulfur, to the extent enacted, could make low sulfur coal less attractive, which could also have a material adverse effect on the demand for and prices received for our coal.

You should see Item 1, “Environmental and Other Regulatory Matters” for more information about the various governmental regulations affecting the market for our products.

Increased pressure from political and regulatory authorities, along with environmental and climate change activist groups, and lending and investment policies adopted by financial institutions and insurance companies to address concerns about the environmental impacts of coal combustion, including climate change, may potentially materially and adversely impact our future financial results, liquidity and growth prospects.

Global climate issues continue to attract significant public and scientific attention. For example, the Fourth and Fifth Assessment Reports of the Intergovernmental Panel on Climate Change have expressed concern about the impacts

of human activity, especially from fossil fuel combustion, on the global climate. As a result of the public and scientific attention, several governmental bodies increasingly are focusing on climate issues and, more specifically, levels of emissions of carbon dioxide from coal combustion by power plants. The Clean Power Plan would severely limit emissions of carbon dioxide, possibly reducing future demand for coal. However, as discussed above, the EPA has sought to replace the Clean Power Plan with the Affordable Clean Energy rule. In January 2021, the D.C. Circuit Court of Appeals vacated the Affordable Clean Energy rule and its implied repeal of the Clean Power Plan, remanding to the EPA for further proceedings , and that proceeding is currently before the Supreme Court; as such, and given that the change in presidential administration could result in a further shift in policy by the EPA, the future of that rule and the Clean Power Plan is uncertain. Additionally, a number of governments pledged to control and reduce greenhouse gas emissions under the Paris Agreement, which may impact demand for coal resources. The Biden administration reentered the Paris Agreement in February 2021.

Future regulation of greenhouse gas emissions in the United States could occur pursuant to future treaty obligations, statutory or regulatory changes at the federal, state or local level or otherwise. The enactment of laws or the passage of regulations regarding greenhouse gas emissions from the combustion of coal by the U.S., some of its states or other countries, or other actions to limit emissions have resulted in, and may continue to result in, electricity generators switching from coal to other fuel sources or coal-fueled power plant closures. Further, policies limiting available financing for the development of new coal-fueled power plants could adversely impact the global demand for coal in the future. You should see Item 1, “Environmental and Other Regulatory Matters-Climate Change” for more information about governmental regulations relating to greenhouse gas emissions.

There have been recent efforts by members of the general financial and investment communities, such as investment advisors, sovereign wealth funds, public pension funds, universities and other groups, to divest themselves and to promote the divestment of securities issued by companies involved in the fossil fuel extraction market, such as coal producers. In California, for example, legislation was signed into law in October 2015 requiring California’s state pension funds to divest investments in companies that generate 50% or more of their revenue from coal mining. Also, in December 2017, the Governor of New York announced that the New York Common Fund would immediately cease all new investments in entities with “significant fossil fuel activities,” and the World Bank announced that it would no longer finance upstream oil and gas after 2019, except in “exceptional circumstances.” Other activist campaigns have urged banks to cease financing coal-driven businesses. As a result, numerous banks, other financing sources and insurance companies have taken actions to limit available financing and insurance coverage for the development of new coal-fueled power plants and coal mines and utilities that derive a majority of their revenue from thermal coal. However, in January 2021, the Office of the Comptroller of the Currency, a top federal banking regulator, issued a final rule that would require banks to provide “fair access” to financial services to companies regardless of industry. The final rule, originally set to take effect April 1, 2021, is targeted at major financial institutions that have made pledges not to lend to the fossil fuel industry. The final rule has not yet been published in the Federal Register. The impact of efforts to divest or promote the divestment from the fossil fuel extraction market may adversely affect the demand for and price of our securities and impact our access to the capital and financial markets.

Any future laws, regulations or other policies of the nature described above may adversely impact our business in material ways. The degree to which any particular law, regulation or policy impacts us will depend on several factors, including the substantive terms involved, the relevant time periods for enactment and any related transition periods. We routinely attempt to evaluate the potential impact on us of any proposed laws, regulations or policies, which requires that we make several material assumptions. From time to time, we determine that the impact of one or more such laws, regulations or policies, if adopted and ultimately implemented as proposed, may result in materially adverse impacts on our operations, financial condition or cash flow. In general, it is likely that any future laws, regulations or other policies aimed at reducing greenhouse gas emissions will negatively impact demand for our coal.

Increased attention to environmental, social or governance ("ESG") matters could adversely impact our business and the value of the company.

Increasing attention to climate change, societal expectations on companies to address climate change, investor and societal expectations regarding voluntary ESG disclosures, and consumer demand for alternative forms of energy may result in negative views with respect to ESG that could result in a low ESG score or similar sustainability score, could harm the perception of our Company by certain investors, or could result in the exclusion of our securities from consideration by those investors.

Certain financial institutions, including banks and insurance companies, have taken actions to limit available financing, insurance and other services to entities that produce or use fossil fuels. Increasingly, the actions of such financial institutions and insurance companies are based upon ESG or sustainability scores, ratings and benchmarking studies provided by various organizations that assess corporate performance and governance related to environmental and social matters, including climate change. Companies in the energy industry, and in particular those focused on coal, natural gas or petroleum extraction and refining, often have lower ESG or sustainability scores compared to companies in other industries. These lower scores may have adverse consequences including, but not limited to:

- restricting our ability to access capital and financial markets in the future or increasing our cost of capital;
- reducing the demand and price for our securities;
- increasing the cost of borrowing;
- causing a decline in our credit ratings;
- reducing the availability, and/or increasing the cost of, third-party insurance;
- increasing our retention of risk through self-insurance; and
- making it more difficult to obtain surety bonds, letters of credit, bank guarantees or other financing.

Moreover, while we may publish voluntary disclosures regarding ESG matters from time to time, many of the statements in those voluntary disclosures are based on hypothetical expectations and assumptions that may or may not be representative of current or actual risks or events, or forecasts of expected risks or events, including the costs associated therewith. Such expectations and assumptions are necessarily uncertain and may be prone to error or subject to misinterpretation given the long timelines involved in measuring and reporting on many ESG matters.

Our failure to obtain and renew permits necessary for our mining operations could negatively affect our business.

Mining companies must obtain numerous permits that impose strict regulations on various environmental and operational matters in connection with coal mining. These include permits issued by various federal, state and local agencies and regulatory bodies. The permitting rules, and the interpretations of these rules, are complex, change frequently and are often subject to discretionary interpretations by the regulators, all of which may make compliance more difficult or impractical, and may possibly preclude the continuance of ongoing operations or the development of future mining operations. The public, including non-governmental organizations, anti-mining groups and individuals, have certain statutory rights to comment upon and submit objections to requested permits and environmental impact statements prepared in connection with applicable regulatory processes, and otherwise engage in the permitting process, including bringing citizens' lawsuits to challenge the issuance of permits, the validity of environmental impact statements or the performance of mining activities. Accordingly, required permits may not be issued or renewed in a timely fashion or at all, or permits issued or renewed may be conditioned in a manner that may restrict our ability to efficiently and economically conduct our mining activities, any of which could materially reduce our production, cash flow and profitability.

Federal or state regulatory agencies have the authority to order certain of our mines to be temporarily or permanently closed under certain circumstances, which could materially and adversely affect our ability to meet our customers' demands.

Federal or state regulatory agencies have the authority, under certain circumstances following significant health and safety incidents, such as fatalities, to order a mine to be temporarily or permanently closed. If this

occurred, we may be required to incur capital expenditures to re-open the mine. In the event that these agencies order the closing of our mines, our coal sales contracts generally permit us to issue *force majeure* notices which suspend our obligations to deliver coal under these contracts. However, our customers may challenge our issuances of *force majeure* notices. If these challenges are successful, we may have to purchase coal from third-party sources, if it is available, to fulfill these obligations, incur capital expenditures to re-open the mines and/or negotiate settlements with the customers, which may include price or commitment reductions, extensions of time for delivery or terminations of customers' contracts. Any of these actions could have a material adverse effect on our business and results of operations.

Extensive environmental regulations impose significant costs on our mining operations, and future regulations could materially increase those costs or limit our ability to produce and sell coal.

The coal mining industry is subject to increasingly strict regulation by federal, state and local authorities with respect to environmental matters such as:

- limitations on land use;
- mine permitting and licensing requirements;
- reclamation and restoration of mining properties after mining is completed and required surety bonds or other instruments to secure those reclamation and restoration obligations;
- management of materials generated by mining operations;
- the storage, treatment and disposal of wastes;
- remediation of contaminated soil and groundwater;
- air quality standards;
- water pollution;
- protection of human health, plant-life and wildlife, including endangered or threatened species;
- protection of wetlands;
- the discharge of materials into the environment;
- the effects of mining on surface water and groundwater quality and availability; and
- the management of electrical equipment containing polychlorinated biphenyls.

The costs, liabilities and requirements associated with the laws and regulations related to these and other environmental matters may be costly and time-consuming and may delay commencement or continuation of exploration or production operations. Failure to comply with these laws and regulations may result in the assessment of administrative, civil and criminal penalties, the imposition of cleanup and site restoration costs and liens, the issuance of injunctions to limit or cease operations, the suspension or revocation of permits and other enforcement measures that could have the effect of limiting production from our operations. We may incur material costs and liabilities resulting from claims for damages to property or injury to persons arising from our operations. If we are pursued for sanctions, costs and liabilities in respect of these matters, our mining operations and, as a result, our profitability could be materially and adversely affected.

New legislation or administrative regulations or new judicial interpretations or administrative enforcement of existing laws and regulations, including proposals related to the protection of the environment that would further regulate and tax the coal industry, may also require us to change operations significantly or incur increased costs, which could have a material adverse effect on our financial condition and results of operations. Please refer to the section entitled "Environmental and Other Regulatory Matters" in Item 1 for more information about the various governmental regulations affecting us.

If the assumptions underlying our estimates of reclamation and mine closure obligations are inaccurate, our costs could be greater than anticipated.

SMCRA and counterpart state laws and regulations establish operational, reclamation and closure standards for all aspects of surface mining, as well as most aspects of underground mining. We base our estimates of reclamation and mine closure liabilities on permit requirements, engineering studies and our engineering expertise related to these requirements. Our management and engineers periodically review these estimates. Actual costs can vary from our original

estimates if our assumptions are incorrect, major operational changes are implemented, or if governmental regulations change significantly. We are required to record new obligations as liabilities at fair value under U.S. GAAP. In estimating fair value, we consider the estimated current costs of reclamation and mine closure and applied inflation rates, together with third-party profit, as required. The third-party profit is an estimate of the approximate markup that would be charged by contractors for work performed on our behalf. The resulting estimated reclamation and mine closure obligations could change significantly if actual amounts change significantly from our assumptions, which could have a material adverse effect on our results of operations and financial condition.

Our operations may impact the environment or cause exposure to hazardous substances, and our properties may have environmental contamination, which could result in material liabilities to us.

Our operations currently use hazardous materials and generate hazardous wastes from time to time. We could become subject to claims for toxic torts, natural resource damages and other damages as well as for the investigation and cleanup of soil, surface water, groundwater, and other media. Such claims may arise, for example, out of conditions at sites that we currently own or operate, as well as at sites that we previously owned or operated, or at sites that we may acquire. Under certain federal and state environmental laws, our liability for such conditions may be joint and several with other owners/operators, so that we may be held responsible for more than our share of the contamination or other damages, or even for the entire share. Liability under these laws is generally strict. Accordingly, we may incur liability without regard to fault or to the legality of the conduct giving rise to the conditions.

We maintain extensive coal refuse areas and slurry impoundments at a number of our mining complexes. Such areas and impoundments are subject to extensive regulation. Slurry impoundments can fail, which could release large volumes of coal slurry into the surrounding environment. Structural failure of an impoundment can result in extensive damage to the environment and natural resources, such as bodies of water that the coal slurry reaches, as well as liability for related personal injuries and property damages, and injuries to wildlife. Some of our impoundments overlie mined-out areas, which can pose a heightened risk of failure and of damages arising out of failure. If one of our impoundments were to fail, we could be subject to substantial claims for the resulting environmental contamination and associated liability, as well as for fines and penalties.

Drainage flowing from or caused by mining activities can be acidic with elevated levels of dissolved metals, a condition referred to as “acid mine drainage,” which we refer to as AMD. The treating of AMD can be costly. Although we do not currently face material costs associated with AMD, it is possible that we could incur significant costs in the future.

These and other similar unforeseen impacts that our operations may have on the environment, as well as exposures to hazardous substances or wastes associated with our operations, could result in costs and liabilities that could materially and adversely affect our business, financial condition and results of operations.

Changes in the legal and regulatory environment could complicate or limit our business activities, increase our operating costs or result in litigation.

The conduct of our businesses is subject to various laws and regulations administered by federal, state and local governmental agencies in the United States. These laws and regulations may change, sometimes dramatically, as a result of political, economic or social events or in response to significant events. Environmental and other non-governmental organizations and activists, many of which are well funded, continue to exert pressure on regulators and other government bodies to enact more stringent laws and regulations. For instance, increasing attention to global climate change has resulted in an increased possibility of governmental investigations and, potentially, private litigation against us and our customers. For example, claims have been made against certain energy companies alleging that greenhouse gas emissions constitute a public nuisance. While our business is not a party to any such litigation, we could be named in actions making similar allegations. Moreover, the proliferation of successful climate change litigation could adversely impact demand for coal and ultimately have a material adverse effect on our business, financial condition and results of operations. Changes in the legal and regulatory environment in which we operate may impact our results, increase our costs or liabilities, complicate or limit our business activities or result in litigation. Such legal and regulatory environment changes may include changes in such items as: the processes for obtaining or renewing permits; federal Lease By Application

("LBA") programs; costs associated with providing healthcare benefits to employees; health and safety standards; accounting standards; taxation requirements; competition laws; and trade policies, including policies concerning tariffs, quotas, trade barriers and other trade protection measures.

Risks Related to Income Taxes

Our ability to use net operating losses and alternative minimum tax credits is subject to a current limitation, and our ability to use net operating losses may be subject to additional limitations.

The ability to use our net operating losses ("NOLs") in existence immediately prior to our emergence from bankruptcy in 2016 has been limited by the "ownership change" under Section 382 of the Internal Revenue Code (the "Code") that occurred as a result of such emergence (the "Emergence Ownership Change"). NOLs generated after the Emergence Ownership Change are generally not subject to the limitations resulting from the Emergence Ownership Change.

In addition, for U.S. federal income tax purposes, NOLs generated in taxable years beginning after December 31, 2017 are not subject to expiration; however, such NOLs can only be used to offset 80% of our U.S. federal taxable income in any taxable year beginning after December 31, 2021. However, if we undergo an additional "ownership change" under Section 382 of the Code (very generally defined as a greater than 50% change, by value, in equity ownership by certain shareholders or groups of shareholders over a rolling three-year period), such ownership change may impose limitations on our ability to use any NOLs in existence immediately prior to such ownership change. We may experience ownership changes as a result of subsequent shifts in our stock ownership. Future legal or regulatory changes could also limit our ability to utilize our NOLs. To the extent we are not able to offset future taxable income with our NOLs, our net income and cash flows may be adversely affected.

U.S. tax legislation may materially adversely affect our financial condition, results of operations and cash flows.

The upcoming congressional elections in the United States could result in further significant changes in, and uncertainty with respect to, tax legislation and regulation directly or indirectly affecting our business. We urge our investors to consult with their legal and tax advisors with respect to the any such future legislation and regulations.

ITEM 1B. UNRESOLVED STAFF COMMENTS.

None.

ITEM 2. PROPERTIES.

Disclosure of Mineral Reserves and Resources

In October 2018, the Securities and Exchange Commission ("SEC") adopted amendments to its current disclosure rules to modernize the mineral property disclosure requirements for mining registrants. The amendments include the adoption of S-K 1300, which will govern disclosure for mining registrants (the "SEC Mining Modernization Rules"). The SEC Mining Modernization Rules replace the historical property disclosure requirements for mining registrants that were included in the SEC's Industry Guide 7 and better align disclosure with international industry and regulatory practices.

Descriptions in this report of our mineral deposits are prepared in accordance with S-K 1300, as well as similar information provided by other issuers in accordance with S-K 1300, may not be comparable to similar information that is presented elsewhere outside of this report. Leer, Leer South, and Black Thunder were considered material properties. Please refer to the Technical Report Summaries filed as exhibits hereto for additional information with respect to our material properties and Material Mining Properties section below.

The qualified persons that have reviewed and approved the scientific and technical information contained in this annual report are identified in the footnotes to the tables summarizing the mineral reserves and resources estimates below. Our coal reserve estimates at December 31, 2021 were prepared by our engineers and geologists and reviewed by

Weir International, Inc. and Marshall Miller and Associates, Inc., which are third party mining and geological consultants. Internally qualified personnel were used for all non-material properties and selected resources.

Refer to Item 1. Business "Our Mining Operations" for further discussion regarding our active mining complexes as of December 31, 2021, including the total tons sold associated with these complexes, mining type, mining equipment, location, existing infrastructure, total cost of property, plant and equipment of each mining complex.

Presentation of information concerning Mineral Reserves

The estimates of proven and probable reserves at our mines and the estimates of mine life included in this annual report have been prepared by the qualified persons referred to herein, and in accordance with the technical definitions established by the SEC. Under S-K 1300:

- Proven mineral reserves are the economically mineable part of a measured mineral resource and can only result from conversion of a measured mineral resource.
- Probable mineral reserves are the economically mineable part of an indicated and, in some cases, a measured mineral resource.
- Indicated mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Because an indicated mineral resource has a lower level of confidence than the level of confidence of a measured mineral resource, an indicated mineral resource may only be converted to a probable mineral reserve.
- Inferred mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Because an inferred mineral resource has the lowest level of geological confidence of all mineral resources, which prevents the application of the modifying factors in a manner useful for evaluation of economic viability, an inferred mineral resource may not be considered when assessing the economic viability of a mining project, and may not be converted to a mineral reserve.
- Measured mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The level of geological certainty associated with a measured mineral resource is sufficient to allow a qualified person to apply modifying factors, as defined in S-K 1300, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit. Because a measured mineral resource has a higher level of confidence than the level of confidence of either an indicated mineral resource or an inferred mineral resource, a measured mineral resource may be converted to a proven mineral reserve or to a probable mineral reserve.

We periodically revise our reserves and resources estimates when we have new geological data, economic assumptions or mining plans. During 2021, we performed an analysis of our reserves and resources estimates for certain operations, which is reflected in new estimates as of December 31, 2021. Reserves and resource estimates for each operation assume that we either have or expect to obtain all the necessary rights and permits to mine, extract and process mineral reserves or resources at each mine. Certain figures in the tables, discussions and notes have been rounded. For a description of risks relating to our estimates of mineral reserves and resources, see our "Risk Factors" within Item 1A.

Our Properties

The following table provides a summary of information regarding our active mining complexes as of December 31, 2021:

Mine[1]	Location	Ownership	Operator	Stage of Development	Mine Type	Processing Plant
Leer[2]	Taylor County, WV	100%	ICG Tygart Valley	Production	Underground	Yes
Leer South[3]	Barbour County, WV	100%	Wolf Run Mining LLC	Production	Underground	Yes
Beckley	Raleigh County, WV	100%	ICG Beckley LLC	Production	Underground	Yes
Mountain Laurel	Logan County, WV	100%	Mingo Logan LLC	Production	Underground	Yes
Black Thunder[4]	Campbell County, WY	100%	Thunder Basin Coal Company L.L.C.	Production	Surface	No
Coal Creek	Campbell County, WY	100%	Thunder Basin Coal Company L.L.C.	Production	Surface	No
West Elk	Gunnison County, CO	100%	Mountain Coal Company L.L.C.	Production	Underground	Yes

(1) The Mineral Reserve estimates with respect to our mines have been prepared by the qualified persons referred to herein. Refer to Item 1. Business "Our Mining Operations" on the title process. Refer to Item 1. Business "Environmental and Other Regulatory Matters" for discussion on the permitting process.

(2) Subpart 1300 of Regulation S-K definitions were followed for Mineral Reserves. The qualified person for Mineral Reserves is Weir Consulting, an independent mining firm. Mineral reserves are estimated at average sales price per short ton FOB mine of $110.18 and average cash cost per short ton of $59.94. Refer to Exhibit 96.1 Technical Report Summary for Leer Mine – S-K 1300 Report.

(3) Subpart 1300 of Regulation S-K definitions were followed for Mineral Reserves. The qualified person for Mineral Reserves is Marshall Miller & Associates, an independent mining firm. Mineral reserves are estimated at average sales price per short ton FOB mine of $98.59 and average cash cost per short ton of $52.39. Refer to Exhibit 96.1 Technical Report Summary for Leer South Mine – S-K 1300 Report.

(4) Subpart 1300 of Regulation S-K definitions were followed for Mineral Reserves. The qualified person for Mineral Reserves is Weir Consulting, an independent mining firm. Mineral reserves are estimated at average sales price per short ton FOB mine of $14.67 and average cash cost per short ton of $12.46. Refer to Exhibit 96.1 Technical Report Summary for Black Thunder Mine – S-K 1300 Report.

At December 31, 2021, we owned or controlled, primarily through long-term leases, approximately 28,292 acres of coal land in Ohio, 952 acres of coal land in Maryland, 10,095 acres of coal land in Virginia, 306,033 acres of coal land in West Virginia, 81,470 acres of coal land in Wyoming, 234,543 acres of coal land in Illinois, 33,047 acres of coal land in Kentucky, 362 acres of coal land in Montana, 248 acres of coal land in Pennsylvania, and 19,018 acres of coal land in Colorado. In addition, we also owned or controlled through long-term leases smaller parcels of property in Alabama, Indiana, Washington, Arkansas, California, Utah and Texas. We lease approximately 57,863 acres of our coal land from the federal government and approximately 15,318 acres of our coal land from various state governments. Certain of our preparation plants or loadout facilities are located on properties held under leases which expire at varying dates over the next 30 years. Most of the leases contain options to renew. Our remaining preparation plants and loadout facilities are located on property owned by us or for which we have a special use permit.

Our executive headquarters occupies leased office space at 1 CityPlace Drive, in St. Louis, Missouri. Our subsidiaries currently own or lease the equipment utilized in their mining operations. You should see Item 1, "Our Mining Operations" for more information about our mining operations, mining complexes and transportation facilities.

Our Coal Reserves

We estimate that we owned or controlled approximately 1.0 billion tons of recoverable mineral reserves and 1.2 billion tons of measurable and indicated resources at December 31, 2021. Our coal reserve estimates at December 31, 2021 were prepared by our engineers and geologists and reviewed by Weir International, Inc., a mining and geological consultant. Our coal reserve estimates are based on data obtained from our drilling activities and other available geologic data. Our coal reserve estimates are periodically updated to reflect past coal production and other geologic and mining data. Acquisitions or sales of coal properties will also change these estimates. Changes in mining methods or the utilization of new technologies may increase or decrease the recovery basis for a coal seam.

Our coal reserve estimates include reserves that can be economically and legally extracted or produced at the time of their determination. In determining whether our reserves meet this standard, we take into account, among other things, our potential inability to obtain a mining permit, the possible necessity of revising a mining plan, changes in estimated future costs, changes in future cash flows caused by changes in costs required to be incurred to meet regulatory requirements and obtaining mining permits, variations in quantity and quality of coal, and varying levels of demand and their effects on selling prices. We use various assumptions in preparing our estimates of our coal reserves. You should see “Inaccuracies in our estimates of our coal reserves could result in decreased profitability from lower than expected revenues or higher than expected costs” contained in Item 1A, “Risk Factors.”

The following table shows our estimates of Mineral Reserves as of December 31, 2021 prepared in accordance with Subpart 1300 of Regulation S-K.

Total Mineral Reserves
(Tons in millions)

Product / Region / Mine	Representative Coal Quality	Recoverable Mineral Reserves (million tons) Proven	Probable	Total
Metallurgical Coal				
Central Appalachia				
Beckley	1	15.4	2.2	17.6
Mountain Laurel	3	10.2	7.6	17.8
VA, Royalty	2	0.7	—	0.7
Total Central Appalachia		26.3	9.8	36.1
Northern Appalachia				
Leer	3	18.1	26.3	44.4
Leer South	3	46.1	18.4	64.5
Other Northern Appalachia	3	47.7	30.8	78.5
Total Northern Appalachia		111.9	75.5	187.4
Total Metallurgical Coal		138.2	85.3	223.5
Thermal Coal				
Colorado	4	46.9	5.0	51.9
Illinois Basin, Royalty	5	144.4	34.2	178.6
Wyoming				
Black Thunder	6	540.0	5.0	545.0
Other Wyoming		—	—	—
Total Wyoming		540.0	5.0	545.0
Total Thermal Coal		731.3	44.2	775.5
Total Coal		869.5	129.5	998.9

(1) Low-Vol
(2) Mid-Vol
(3) High-Vol
(4) 11,500 BTU/lbs.; 0.92 lbs. SO2/MMBTU
(5) 11,200 BTU/lbs.; 4.95 lbs. SO2/MMBTU
(6) 8900 BTU/lbs.; 0.67 lbs. SO2/MMBTU
(7) The Mineral Reserve estimates with respect to our mines have been prepared by the qualified persons referred to herein.

The following table shows our estimates of Mineral Resources as of December 31, 2021 prepared in accordance with Subpart 1300 of Regulation S-K.

Total Mineral Resources
(Tons in millions)

		In-Place Mineral Resources (million tons)			
Product / Region / Mine	Representative Coal Quality	Measured	Indicated	Measured + Indicated	Inferred
Metallurgical Coal					
Central Appalachia					
Mountain Laurel	3	2.5	17.6	20.1	23.2
VA, Royalty	2	10.3	—	10.3	—
Total Central Appalachia		12.8	17.6	30.4	23.2
Northern Appalachia					
Leer	3	2.4	11.6	14.0	4.9
Leer South	3	8.9	4.0	12.9	—
Other Northern Appalachia	3	85.8	109.9	195.7	0.9
Total Northern Appalachia		97.0	125.6	222.6	5.8
Total Metallurgical Coal		109.8	143.2	253.0	29.0
Thermal Coal					
Colorado		—	—	—	—
Illinois Basin					
Macoupin County, IL	4	—	170.6	170.6	—
Other Illinois Basin	5	21.4	106.0	127.4	56.2
Total Illinois Basin		21.4	276.6	298.0	56.2
Wyoming					
Black Thunder	6	200.0	5.0	205.0	—
Coal Creek	7	133.5	1.2	134.7	—
Other Campbell County	8	266.0	10.4	276.4	—
Total Wyoming		599.5	16.6	616.1	—
Total Thermal Coal		620.9	293.2	914.1	56.2
Total Coal		730.8	436.4	1,167.1	85.2

(1) Low-Vol
(2) Mid-Vol
(3) High-Vol
(4) 11,565 BTU/lbs, 9.7 lbs. SO2/MMBTU
(5) 10,200 - 11,900 BTU/lbs; 6.1 - 9.7 lbs. SO2/MMBTU
(6) 8985 BTU/lbs.; 0.6 lbs. SO2/MMBTU
(7) 8175 BTU/lbs.; 0.8 lbs. SO2/MMBTU
(8) 8200 - 9100 BTU/lbs.; 0.6 - 0.9 lbs. SO2/MMBTU
(9) The estimation of Mineral Resources involves assumptions about future commodity prices and technical mining matters. Resources are not mineral reserves and do not have demonstrated economic viability.

Federal and state legislation controlling air pollution affects the demand for certain types of coal by limiting the amount of sulfur dioxide which may be emitted as a result of fuel combustion and encourages a greater demand for low-sulfur coal. All of our identified coal reserves have been subject to preliminary coal seam analysis to test sulfur content. Of these reserves, approximately 60% consist of compliance coal, or coal which emits 1.2 pounds or less of sulfur dioxide per million Btus upon combustion, while an additional approximately 10% could be sold as low-sulfur coal. The balance is classified as high-sulfur coal. Most of our reserves are suitable for the domestic steam coal markets. A substantial portion of the low-sulfur and compliance coal reserves at a number of our Appalachian mining complexes may also be used as metallurgical coal.

The carrying cost of our coal reserves at December 31, 2021 was $263.9 million, consisting of $4.1 million of prepaid royalties and a net book value of coal lands and mineral rights of $259.8 million.

Material Mining Properties

The information that follows relating our material properties: Leer, Leer South, Black Thunder – is derived from, and in some instances is an extract from, the technical report summaries ("TRSs") relating to such properties prepared in compliance with Item 601(b)(96) and subpart 1300 of Regulation S-K. Portions of the following information are based on assumptions, qualifications and procedures that are not fully described herein. Reference should be made to the full text of the TRSs, incorporated herein by reference and made a part of this Annual Report on Form 10-K.

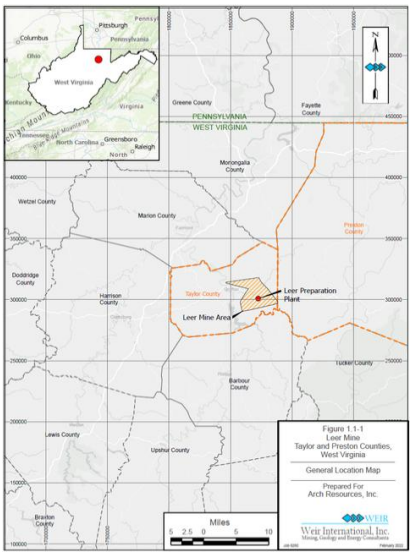
The following table shows our estimates of Mineral Reserves as of December 31, 2021 prepared in accordance with Subpart 1300 of Regulation S-K for our material mining properties:

	Recoverable Mineral Reserves (As-Received) (million tons)					
Product / Region / Mine	Proven	Probable	2021 Total	2020 Total	Percentage Change	Notes
Metallurgical Coal						
Northern Appalachia						
Leer	18.1	26.3	44.4	50.3	(11.8)%	1,2
Leer South	46.1	18.4	64.5	46.3	39.4%	1,2
Thermal Coal						
Wyoming						
Black Thunder	540.0	5.0	545.0	699.3	(22.1)%	1,2,3

(1) Year 2021 production
(2) Modifications to Life of Mine Plan
(3) Selected December 31, 2020 reserve tons were reclassified to resource

Leer

Leer is located at approximately 39° 19' 59.8584" N Latitude and 79° 57' 30.7584" W Longitude, which is approximately 25 miles south of Morgantown, West Virginia, primarily in Taylor County, with minimal extension into Preston County, within the Northern West Virginia coal field of the NAPP Region of the United States. The USGS 7.5-minute quadrangle map sheets are Fairmont East, Gladesville, Grafton, and Thornton.



Leer is a permitted underground longwall mine that commenced production of metallurgical coal in the fourth quarter of 2011. The longwall mining method has been successfully utilized in the Northern Appalachia Region, and in other coal producing regions of the United States, since the 1960s. Longwall mining has the highest mining recovery of modern-day underground mining methods. Longwall mining includes room and pillar continuous mining to develop main entries, longwall headgates and tailgates, and retreat mining production panels.

Leer is mining the Lower Kittanning Seam and parting interval within the seam utilizing continuous miners to develop longwall panels to be mined using a longwall mining system. Leer is primarily sold as High-Vol A, and is part of approximately 93,100 acres that is considered our Tygart Valley area. Leer develops longwall districts (sets of adjacent longwall panels) with alphabetic designations.

Prior to the development of Leer, there was very little mining that occurred on the property. A small underground coal mine operated by the Thornton Fire Brick Company was located in the Upper Freeport Seam to the southeast of Thornton, West Virginia. This mine was located off of Three Fork Creek and operated in the early 1900s. The Thornton Fire Brick Company also operated a surface mine or “clay pit” near Thornton, West Virginia, mining fireclay for brickmaking in the early 1900s. Available maps show an underground mine, of limited extent, in the Lower Kittanning

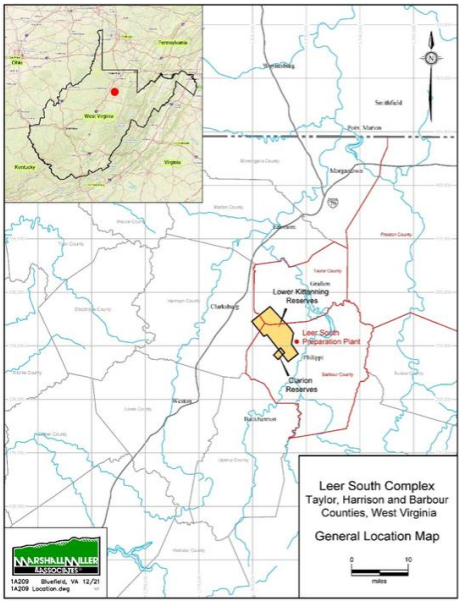
Seam to the south of Leer on the east side of Frog Run. Available data shows this as Sterling Coal Company's Cecil coal mine, with mining shown to have occurred in the early 1900s.

Leer's surface facilities are located within the Leer permit area, near central area of the mid-north boundary of the permit. The surface facilities include mine administration, engineering and operations offices, coal preparation plant, rail loadout, mine maintenance facilities, warehouse facilities, parking lots, preparation plant waste disposal, settling ponds, and Leer slope portal access. The total disturbed area for the Leer surface facilities is approximately 200 acres.

All the production is processed through a 1,400 ton-per-hour preparation plant and loaded on the CSX railroad. A 15,000-ton train can be loaded in less than four hours. Sources of electrical power, water, supplies, and materials are readily available. Electrical power is provided to the mines and facilities by regional utility companies. Water is supplied by public water services, surface impoundments, or water wells. Leer is projected to employ a maximum of 508 personnel over the life of mine plan and Leer employed approximately 501 personnel at the end of January 2021. The hourly labor force remains non-union and no change in this labor arrangement is anticipated in the short term. The total cost of Leer and its associated plant and equipment as of December 31, 2021 is approximately $279.6 million.

Leer South

Leer South is located at approximately 39° 11' 55.0572" N Latitude and 80° 3' 33.5088" W Longitude, which is approximately located near Nin Barbour, Harrison, and Taylor Counties in West Virginia. Leer South office is located north of the town of Philippi, the county seat of Barbour County, West Virginia. The nearest cities are Clarksburg and Bridgeport, approximately 17 miles to the northwest. The city of Buckhannon is located 26 miles to the south of the mine. Charleston, the state capital of West Virginia, is located approximately 136 miles southwest of the Property.



Leer South consists of the newly commenced longwall Leer South operation in the Lower Kittanning seam, existing Sentinel underground mine in the Clarion seam, a preparation plant and a loadout facility located on approximately 26,000 acres in Barbour County, West Virginia.

Arch has obtained all mining and discharge permits to operate its mine and processing, loadout, and related support facilities. A significant portion of the reserves at Leer South are owned rather than leased from third parties. Since 1974, the Property has been controlled by various mining companies including (in chronological order: Republic Steel Corporation, Old Ben Coal Company, Black Diamond Energy Inc., Anker Mining Company (Anker), International Coal Group (ICG), and Arch. Mine development in the Clarion seam was started by ICG in 2006, and expansion into the Lower Kittanning seam was begun by Arch in 2018.

Due to its coal reserve and seam characteristics, Leer South operates using longwall (in the Lower Kittanning) methods and continuous mining (in the Clarion seam) methods. Resource and reserve models were therefore generated

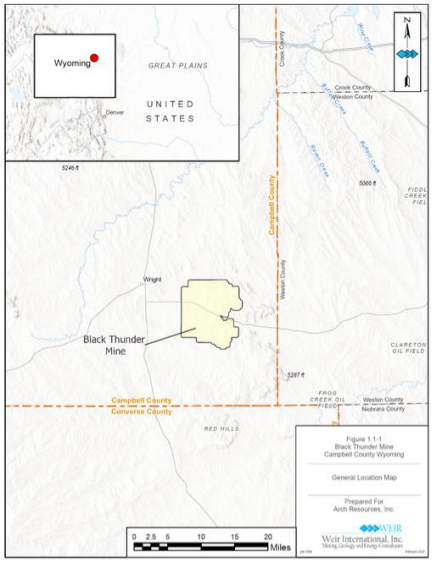
with both longwall and continuous-mining constraints in mind for Leer South's underground resources. The mines produce coal that is suitable for the high-volatile metallurgical coal markets.

Underground infrastructure has recently been upgraded to accommodate the addition of longwall mining in the Lower Kittanning Seam. Highlights include: The belt haulage has been upgraded on the main slope, Belt infrastructure has been upgraded to accommodate increased tonnages from all Lower Kittanning sections to the main slope. A rail system has been added as a transport method for personnel, equipment, and supplies. Three slopes have been driven from the Clarion Seam to the overlying Lower Kittanning Seam. A coal storage bunker system has been constructed at the Lower Kittanning Seam interface. A ventilation shaft has been added to supply intake air from the Clarion workings and return air to the surface. A power upgrade has occurred including a new 138,000-volt substation and tap to the utility. A bath house addition constructed adjacent to the existing facility to accommodate the larger workforce. A bleeder shaft and fan has been installed to support the initial longwall mining district in the Lower Kittanning seam. Plant and coal handling facilities were upgraded to handle longwall volumes and include a 1,600 ton-per-hour preparation plant located near the mine, as well as a loadout facility served by the CSX railroad and connected to the plant by a 4,000 ton-per-hour conveyor system. The loadout facility is capable of loading a 15,000 ton unit train in less than four hours. The total cost of Leer South and its associated plant and equipment as of December 31, 2021 is approximately $621.9 million. Sources of electrical power, water, supplies, and materials are readily available. Electrical power is provided to the mines and facilities by regional utility companies. Water is supplied by public water services, surface impoundments, or water wells. A total of approximately 600 non-unionized salary and hourly employees are assigned to Leer South.

Black Thunder

Black Thunder is located at approximately 43° 41' 49.8012" N Latitude and 105° 17' 20.3496" W Longitude, which is approximately 50 miles south of Gillette, Wyoming in Campbell County, within the PRB coal producing region of the United States. The United States Geological Survey (USGS) 7.5-minute quadrangle map sheets, upon which the Black Thunder can be found, are Hilight, Open A Ranch, Reno Reservoir, Piney Canyon NW, Teckla and Piney Canyon SW. The Black Thunder permit area includes approximately 62,066 acres of controlled mineral property.

Black Thunder surface facilities are located within the Black Thunder permit area, near the central area of the mid-north boundary of the permit. The surface facilities include mine administration, engineering, and operations offices, mine roads, laydown areas, ponds, crushers, rail loadouts, mine maintenance facilities, warehouse facilities, parking lots. The total disturbed area for Black Thunder surface facilities is approximately 3,230 acres. The coal, backfill, and topsoil stockpiles represent approximately 5,300 additional acres of disturbed area.



We control a significant portion of the coal reserves through federal and state leases. All of the leases have a production royalty rate of 12.5 percent of the Gross Sales Price (GSP). The leases have a minimum royalty that must be paid annually in order to maintain the lease, with the exception of one lease, which has a one-time minimum royalty payment.

Prior to the development of Black Thunder, there was no mining that occurred on the property. Black Thunder is a surface coal mine utilizing draglines and truck/shovel mining equipment for overburden removal. The mine was opened by Atlantic Richfield Company (ARCO) in 1977 and has been operated under Thunder Basin Coal Company, LLC since that time. In 1998, Arch purchased all of ARCO's domestic coal operations, which included the Thunder Basin Coal Company, Black Thunder. In 2004, Arch purchased the adjacent North Rochelle Mine from Triton Coal Company and merged it into Black Thunder. The former North Rochelle Mine facilities and reserves were subsequently sold to Peabody

Coal Company in 2006. In 2009, Arch purchased the adjacent Jacobs Ranch Mine from Rio Tinto Coal and merged it into Black Thunder, which created a mining complex that produced 116.2 million tons of coal in 2010.

Black Thunder currently consists of four active pit areas and two active loadout facilities. We ship all of the coal raw to our customers via the Burlington Northern Santa Fe and Union Pacific railroads. We do not process the coal mined at this complex. Each of the loadout facilities can load a 15,000-ton train in less than two hours.

Mine facilities built by Atlantic Richfield Company included a rail spur and loadout loop, a loadout with two 12,500-ton silos, a 100,000-ton slot storage barn, two crusher locations, a coal analysis lab, maintenance shop, warehouse, bathhouse, reclamation shop, and an administrative building. Initial pit development was conducted with truck/shovel mining equipment, but ARCO subsequently added three draglines by the time the mine was acquired by Arch. The Jacobs Ranch Mine also constructed mine facilities similar to those constructed by ARCO, however, as time progressed and mining moved farther west, these facilities, including the loadout, have been idled. The Jacobs Ranch Mine was historically one of the larger truck/shovel mines until a Bucyrus-Erie 2570W dragline with a 121 cubic yard bucket was brought on-line in 2006. Water is supplied by public water services, surface impoundments, or water wells. Black Thunder staffing includes approximately 1,010 non-unionized employees and will range from 1,078 employees to 259 employees once the mine is near the end of life. The total cost of Black Thunder and its associated plant and equipment as of December 31, 2021 is approximately $279.6 million.

Internal Control Disclosure

Quality control procedures followed by Arch geologists are clearly defined. These procedures include the field geologist to be on site wherever drilling is occurring. On completion of a core run, the core is logged and the samples are sealed in plastic sample bags. These samples do not leave the geologists possession once they have been removed from the core barrel. The geologist is required to keep a written detailed log of each drill hole. Rock quality designation logs are to be prepared for roof and floor start for all underground mineable seams. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. In order to keep the chain of custody clear, the core samples are stored in a locked facility, that only Arch geologists have access to, until the core is delivered to the laboratory for analysis.

In our exploration and mineral resource and reserve estimation efforts, we utilize an American National Standards Institute (ANSI) certified third party laboratory, which has in-house quality control and assurance procedures. Once in possession of the samples, the laboratory standard sample preparation and security procedures are followed. After the sample has been tested, reviewed, and accepted, the disposal of the sample is done in accordance with local, state and EPA approved methods.

Weir International, Inc. (WEIR), an independent mining and geology engineering firm, has reviewed Arch's procedures and determined the sample preparation, security and analysis procedures used for the drill hole samples meet coal industry standards and practices for quality testing, with laboratory results suitable to use for geological modeling, mineral resource estimation and economic evaluation.

Year-end reserve estimates are and will continue to be reviewed by our Chief Executive Officer and other senior management, and revisions are communicated to our board of directors. Inaccuracies in our estimates of our coal reserves could result in decreased profitability from lower than expected revenue or higher than expected costs. Actual production recovered from identified reserve areas and properties, and revenue and expenditures associated with our mining operations, may vary materially from estimates.

Title to Coal Property

Title to coal properties held by lessors or grantors to us and our subsidiaries and the boundaries of properties are normally verified at the time of leasing or acquisition. However, in cases involving less significant properties and consistent with industry practices, title and boundaries are not completely verified until such time as our independent operating subsidiaries prepare to mine such reserves. If defects in title or boundaries of undeveloped reserves are

discovered in the future, control of and the right to mine such reserves could be adversely affected. You should see “A defect in title or the loss of a leasehold interest in certain property or surface rights could limit our ability to mine our coal reserves or result in significant unanticipated costs” contained in Item 1A, “Risk Factors” for more information.

At December 31, 2021, approximately 33% of our coal reserves were held in fee, with the balance controlled by leases, most of which do not expire until the exhaustion of mineable and merchantable coal. Under current mining plans, substantially all reported leased reserves will be mined out within the period of existing leases or within the time period of assured lease renewals. Royalties are paid to lessors either as a fixed price per ton or as a percentage of the gross sales price of the mined coal. The majority of the significant leases are on a percentage royalty basis. In some cases, a payment is required, payable either at the time of execution of the lease or in annual installments. In most cases, the prepaid royalty amount is applied as a credit against future production royalty obligations.

From time to time, lessors or sublessors of land leased by our subsidiaries have sought to terminate such leases on the basis that such subsidiaries have failed to comply with the financial terms of the leases or that the mining and related operations conducted by such subsidiaries are not authorized by the leases. Some of these allegations relate to leases upon which we conduct operations material to our consolidated financial position, results of operations and liquidity, but we do not believe any pending claims by such lessors or sublessors have merit or will result in the termination of any material lease or sublease.

We leased approximately 73,391 acres of property to other coal operators in 2021. We received royalty income of $5.2 million during 2021 from the mining of approximately 2.9 million tons, $5.7 million during 2020 from the mining of approximately 1.7 million tons and $4.5 million during 2019 from the mining of approximately 1.8 million tons on those properties. We have included reserves at properties leased by us to other coal operators in the reserve figures set forth in this report.

ITEM 3. LEGAL PROCEEDINGS.

We are involved in various claims and legal actions arising in the ordinary course of business, including employee injury claims. After conferring with counsel, it is the opinion of management that the ultimate resolution of these claims, to the extent not previously provided for, will not have a material effect on our consolidated financial condition, results of operations or liquidity.

ITEM 4. MINE SAFETY DISCLOSURES.

The statement concerning mine safety violations or other regulatory matters required by Section 1503(a) of the Dodd-Frank Wall Street Reform and Consumer Protection Act and Item 104 of Regulation S-K is included in Exhibit 95 to this Annual Report on Form 10-K for the period ended December 31, 2021.

PART II

ITEM 5. MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES.

Our common stock is listed on the New York Stock Exchange ("NYSE") under the symbol "ARCH" and has been trading since October 5, 2016 upon our emergence from bankruptcy. No prior established public trading market existed for this newly issued common stock prior to this date. Based upon information provided by our transfer agent, as of January 31, 2022, we had 5 stockholders of Class A common stock and 1 stockholder of Class B common stock on record. As many of our shares are held by brokers and other institutions on behalf of shareholders, we are unable to estimate the total number of beneficial holders of our common stock represented by these record holders.

Holders of our common stock are entitled to receive dividends when they are declared by our Board of Directors. We paid dividends on our common stock totaling $3.8 million in 2021. There is no assurance as to the amount or payment of dividends in the future because they will be subject to ongoing Board review and authorization will be based on a number of factors, including business and market conditions, the Company's future financial performance and other capital priorities.

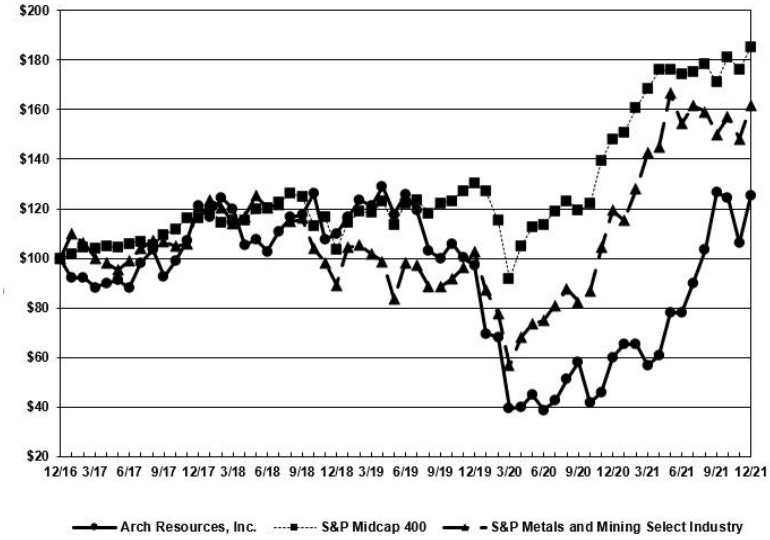
Stockholder Return Performance Presentation

The following graph compares the cumulative five year total return of holders of Arch Resources, Inc.'s common stock with the cumulative total returns of the S&P Midcap 400 index and the S&P Metals and Mining Select Industry index. The graph assumes that the value of the investment in our common stock, the S&P Midcap 400 index, and the S&P Metals and Mining Select Industry index (including reinvestment of dividends) was $100 on December 31, 2016 and tracks it through December 31, 2021.

In 2020, the Dow Jones US Coal Index was discontinued. To mitigate the impact of these fluctuations and provide more consistency to the performance graph disclosure year after year, in 2021, we elected to replace the Dow Jones US Coal Index with the S&P Metals Mining Select Industry Index for disclosure purposes.

COMPARISON OF 5 YEAR CUMULATIVE TOTAL RETURN*

Among Arch Resources, Inc., the S&P Midcap 400 Index,
and the S&P Metals and Mining Select Industry Index



*$100 invested on 12/31/16 in stock or index, including reinvestment of dividends.
Fiscal year ending December 31.

	12/31/16	12/31/17	12/31/18	12/31/19	12/31/20	12/31/21
Arch Resources, Inc.	100.00	121.02	109.78	97.01	59.82	125.19
S&P Midcap 400	100.00	116.24	103.36	130.44	148.26	184.96
S&P Metals and Mining Select Industry	100.00	120.63	89.20	102.43	119.27	161.58

The stock price performance included in this graph is not necessarily indicative of future stock price performance.

Issuer Purchases of Equity Securities

During April 2019, the Board of Directors of Arch Resources, Inc. approved an incremental $250 million to the share repurchase program bringing the total authorization to $1.05 billion. We did not purchase any shares of our common stock under this program for the year ended December 31, 2021.

As of December 31, 2021, we had repurchased 10,088,378 shares at an average share price of $82.01 per share for an aggregate purchase price of approximately $827 million since inception of the stock repurchase program, and the remaining authorized amount for stock repurchases under this program is $223 million.

The timing of any future share repurchases, and the ultimate number of shares purchased, will depend on a number of factors, including business and market conditions, the Company's future financial performance and other capital priorities. The shares will be acquired in the open market or through private transactions in accordance with the Securities and Exchange Commission requirements. The share repurchase program has no termination date, but may be amended, suspended or discontinued at any time and does not commit the Company to repurchase shares of its common stock. The actual number and value of the shares to be purchased will depend on the performance of the Company's stock price and other market conditions.

ITEM 7. MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS.

COVID-19

In the first quarter of 2020, COVID-19 emerged as a global pandemic. The continuing responses to the COVID-19 outbreak include actions that have a significant impact on domestic and global economies, including travel restrictions, gathering bans, stay at home orders, and many other restrictive measures. All of our operations have been classified as essential in the states in which we operate. We instituted many policies and procedures, in alignment with CDC guidelines along with state and local mandates, to protect our employees during the COVID-19 outbreak. These policies and procedures included, but were not limited to, staggering shift times to limit the number of people in common areas at one time, limiting meetings and meeting sizes, continual cleaning and disinfecting of high touch and high traffic areas, including door handles, bathrooms, bathhouses, access elevators, mining equipment, and other areas, limiting contractor access to our properties, limiting business travel, and instituting work from home for administrative employees. We continually evaluate our policies and procedures, in accordance with CDC, state, and local guidelines, and make any necessary adjustments to respond to the particular circumstances in the areas in which we operate. During the second half of 2021, the advent of the Delta and Omicron variants has led to increased infection rates among our workforce at certain operations, and we have reinstated stricter protocols at affected operations. During the second half of 2021, over fifty unit production shifts in our metallurgical segment were adversely impacted by staffing shortfalls related to increased COVID-19 case rates, and our requisite quarantine protocols. We continue to encourage vaccination among our workforce and adjust our COVID-19 responses.

We recognize that the COVID-19 outbreak and responses thereto also continue to impact both our customers and suppliers. To date, we have not had any significant issues with critical suppliers, and we continue to communicate with them and closely monitor developments to ensure we have access to the goods and services required to maintain our operations. Our customers have reacted, and continue to react, in various ways and to varying degrees to changes in demand for their products. In early 2022, increased case rates have negatively impacted rail transportation, primarily for our export shipments. We remain in close communication with our rail service providers, and work diligently with them to mitigate potential delays. Our current view of our customer demand and logistics situation is discussed in greater detail in the "Overview" section below.

Overview

Our results for the year ended December 31, 2021 benefited from improvement in metallurgical and thermal coal markets. Global economic growth accelerated over the course of the year as pent up demand from the responses to the global pandemic seeks to be fulfilled. Global steel production in 2021 is likely to exceed pre-pandemic levels, and energy demand is increasing with economic growth. At the same time, certain metallurgical and thermal coal producing jurisdictions were, at times during 2021, adversely impacted by the resurgence of COVID-19 and its variants, weather, and logistical constraints. Specifically, the major coal producing regions in Australia, Indonesia, China, Mongolia, and western Canada have been adversely impacted by one or more of these factors at various points throughout 2021. Through the year ended December 31, 2021, these constraints have had a relatively minor impact on our shipment volumes, although we did have one coking coal vessel and one thermal coal vessel that we planned to ship late in the fourth quarter of 2021, delayed to early 2022. On December 30, 2021, an explosion occurred at the Curtis Bay Terminal, one of two United States East Coast terminals we utilize to export our coking coal product overseas. This event, coupled with the increased COVID-19 case rates our rail service providers are experiencing, has negatively impacted our volume of coking coal shipments in the first quarter of 2022. While we are working diligently with our rail service provider to mitigate these impacts, our first quarter of 2022 coking coal shipment volume could be as much as 25% below our coking coal shipment volume in the fourth quarter of 2021. At this time, we believe we will make up the first quarter of 2022 shipment shortfall over the course of the remainder of 2022; however, our ability to make up this shortfall will, at least in part, be based on factors that are outside of our direct control.

During the year ended December 31, 2021, accelerating global economic growth, led to historically high steel prices. Steel prices did moderate some late in the year, but remain at levels that provide steel producers with healthy margins. On the coking coal supply side, production and supply chain constraints combined to drive international coking coal indices to historically high levels. Despite these historically high coking coal prices, North American coking coal supply remains constrained compared to pre-COVID-19 levels. Some new supplies have been added to the market, in particular, our new Leer South longwall operation that has been be ramping up production throughout the fourth quarter of 2021. Still, some of the high cost coking coal mine idlings announced during 2020 remain in place, and more recent supply disruptions also constrain supply. The duration of specific supply disruptions is unknown. We believe that underinvestment in the sector in recent years underlies the current market situation. In the current environment, we expect coking coal prices to be volatile. Longer term, we believe continued limited global capital investment in new coking coal production capacity, normal reserve depletion, and continuing economic growth will provide support to coking coal markets.

During the fourth quarter of 2020, a major political dispute that manifested itself as a trade dispute, escalated between China, a major importer of coking coal, and Australia, the world's largest exporter of coking coal. Specifically, China has effectively banned the import of coking coal and thermal coal, among other export products, from Australia. Historical trade patterns remain disrupted, and new trade patterns have emerged in the international coking coal markets. Indices for United States (US) East Coast coking coal reached historically high levels in the second half of 2021 and retained most of the increase through the end of the year. In late October, China decided to allow several million tons of impounded Australian coal to clear customs and enter their domestic market. Release of this previously impounded coal alleviated supply constraints and reduced index pricing for coking coal delivered to China. Lower pricing for coal delivered to China did weigh on US East Coast coking coal indices in the fourth quarter of 2021; however, due to increased demand for coking coal outside of China and related strength of Australian Premium Low Volatile ("PLV") coking coal indices, the impact on US East Coast coking coal indices has been muted. Despite historically high PLV indices, Australian export volumes remain below pre-pandemic levels. China has also reduced domestic steel production during the fourth quarter of 2021. Continuing reduction in Chinese steel production could negatively impact coking coal prices, but a return to previous production levels could positively impact coking coal prices.

Domestic thermal coal consumption increased during the year ended December 31, 2021, compared to the year ended December 31, 2020, due to significantly increased natural gas prices and economic recovery from the responses to COVID-19. Longer term, we continue to believe thermal coal demand will remain pressured by planned closure of coal fueled generating facilities, continuing increases in subsidized renewable generation sources, particularly wind and solar, and the development of battery storage to support the increase in intermittent renewable generation sources. However, during 2021, the significant increase in natural gas prices led to an increase in coal fired generation. We believe coal generator stockpiles likely declined significantly during 2021, and domestic thermal coal indices have reached historically high levels. Importantly, this increase in domestic prices has allowed us to place significant volumes of domestic thermal coal business at prices meaningfully higher than those seen prior to the third quarter of 2021. During the year ended December 31, 2021, international thermal coal indices also increased to historical highs, and although pricing retreated some during the fourth quarter of 2021, international thermal coal indices remain at levels that economically support exports from our thermal operations.

On September 29, 2020, the U.S. District Court ruled against our proposal with Peabody to form a joint venture that would have combined our Powder River Basin and Colorado mining operations with Peabody's, and we subsequently announced the termination of our joint venture efforts. We continue to pursue other strategic alternatives for our thermal assets, including, among other things, potential divestiture. We are concurrently shrinking our operational footprint at our thermal operations. During the year ended December 31, 2021, we completed approximately $33.5 million of Asset Retirement Obligation (ARO) work at these operations, compared to approximately $6.8 million in the year ended December 31, 2020. During the fourth quarter of 2021 we established a fund to pay for future ARO costs at our thermal operations, with an initial $20 million deposit. We plan to continue to grow this self-funding mechanism for our long-term reclamation ARO liabilities at our thermal operations. For further information on this fund, see Note 16, "Asset Retirement Obligations" to the Consolidated Financial Statements. During the current year, we exercised our operational flexibility to maximize cash generation from our thermal operations, and plan to do so again in the coming year. Longer term, we will maintain our focus on aligning our thermal production rates with the secular decline in domestic thermal coal demand, while adjusting our thermal operating plans to minimize future cash

requirements and maintain flexibility to react to future short-term market fluctuations. We continue to streamline our entire organizational structure to reflect our long-term strategic direction as a leading producer of metallurgical products for the steelmaking industry.

During the fourth quarter of 2021, we sold our 49.5% equity interest in Knight Hawk Holdings, LLC. For further information on the sale of and our prior equity investment in Knight Hawk Holdings, LLC, please see Note 4, “Divestitures”, and Note 11, “Equity Method Investments and Membership Interests in Joint Ventures” to the Consolidated Financial Statements.

On December 31, 2020, we sold our Viper operation in Illinois, which had been part of our Other Thermal segment, to Knight Hawk Holdings, LLC. Viper’s results for the full year of 2020 are included in our full year 2020 results, and in all preceding periods’ results presented herein. For further information on the sale of Viper and our prior equity investment in Knight Hawk Holdings, LLC, please see Note 4, “Divestitures”, and Note 11, “Equity Method Investments and Membership Interests in Joint Ventures” to the Consolidated Financial Statements.

The following discussion and analysis are for the year ended December 31, 2021, compared to the same period in 2020 unless otherwise stated. For a discussion and analysis of the year ended December 31, 2020, compared to the same period in 2019, please refer to Management’s Discussion and Analysis of Financial Condition and Results of Operations included in Part II, Item 7 of our Annual Report on Form 10-K for the year ended December 31, 2020, filed with the SEC on February 12, 2021.

Results of Operations

Year Ended December 31, 2021 and 2020

Revenues. Our revenues include sales to customers of coal produced at our operations and coal purchased from third parties. Transportation costs are included in cost of coal sales and amounts billed by us to our customers for transportation are included in revenues.

Coal sales. The following table summarizes information about our coal sales for the years ended December 31, 2021 and 2020:

	Year Ended December 31,		
	2021	2020	(Decrease) / Increase
		(In thousands)	
Coal sales	$ 2,208,042	$ 1,467,592	$ 740,450
Tons sold	73,005	63,343	9,662

On a consolidated basis, coal sales in 2021 increased $740.5 million or 50.5% from 2020, and tons sold increased 9.7 million tons, or 15.3%. Coal sales from Metallurgical operations increased $507.6 million due primarily to higher realized pricing and secondarily increased volume. Thermal coal sales increased $255.8 million due to increased pricing and volume. In the year ended December 31, 2020, our Viper operation, which was sold in December 2020, provided approximately $34.3 million in coal sales and 0.9 million tons sold. See discussion in “Operational Performance” for further information about segment results.

Costs, expenses and other. The following table summarizes costs, expenses and other components of operating income for the years ended December 31, 2021 and 2020:

	Year Ended December 31,		
	2021	2020	Increase (Decrease) in Net Income
	(In thousands)		
Cost of sales (exclusive of items shown separately below)	$ 1,579,836	$ 1,378,479	$ (201,357)
Depreciation, depletion and amortization	120,327	121,552	1,225
Accretion on asset retirement obligations	21,748	19,887	(1,861)
Change in fair value of coal derivatives and coal trading activities, net	(2,392)	5,219	7,611
Selling, general and administrative expenses	92,342	82,397	(9,945)
Costs related to proposed joint venture with Peabody Energy	—	16,087	16,087
Asset impairment and restructuring	—	221,380	221,380
Gain on property insurance recovery related to Mountain Laurel longwall	—	(23,518)	(23,518)
Loss (Gain) on divestitures	24,225	(1,505)	(25,730)
Other operating loss (income), net	4,826	(22,246)	(27,072)
Total costs, expenses and other	$ 1,840,912	$ 1,797,732	$ (43,180)

Cost of sales. Our cost of sales for the year ended December 31, 2021 increased $201.4 million, or 14.6%, versus the year ended December 31, 2020. In the prior year period, our Viper operation, which was sold in December 2020, accounted for approximately $45.5 million in cost of sales. The increase in cost of sales at ongoing operations is directly attributable to higher sales volumes and prices; which consists of increased transportation costs of approximately $118.3 million, increased repairs and supplies costs of approximately $90.5 million, increased operating taxes and royalties of approximately $72.8 million, and increased compensation costs of approximately $21.1 million. These cost increases were partially offset by an increase in credit for ARO reclamation work completed primarily in our Thermal Segment of approximately $24.7 million and decreased purchased coal cost of approximately $16.4 million. See discussion in “Operational Performance” for further information about segment results.

Depreciation, depletion and amortization. Our depreciation, depletion and amortization costs for the year ended December 31, 2021 decreased slightly versus the year ended December 31, 2020 primarily due to the reduced depreciation expense resulting from the asset impairment we recorded in the third quarter of 2020 in our Thermal Segment, partially offset by the increased depreciation of plant and equipment, amortization of development, and depletion in our Metallurgical Segment.

Accretion on asset retirement obligations. The increase in accretion expense in the year ended December 31, 2021 is primarily related to the changes in the planned timing of reclamation work to be completed in our Thermal Segment, specifically at the Coal Creek mine.

Change in fair value of coal derivatives and coal trading activities, net. The benefit in the year ended December 31, 2021 is primarily related to mark-to-market gains on coal derivatives that we had entered to hedge our price risk for anticipated international thermal coal shipments, while we had mark-to-market losses on such coal derivatives for the year ended December 31, 2020.

Selling, general and administrative expenses. Selling, general and administrative expenses in the year ended December 31, 2021 increased versus the year ended December 31, 2020 due primarily to increased compensation costs of approximately $11.3 million, primarily related to higher incentive compensation accruals recorded in the year ended December 31, 2021, partially offset by reduced information technology related costs of approximately $1.1 million.

Costs related to proposed joint venture with Peabody Energy. We incurred expenses of $16.1 million in the year ended December 31, 2020 associated with the regulatory approval process related to the proposed joint venture with Peabody that was terminated jointly by the parties following the Federal Trade Commission’s successful lawsuit to block

the joint venture. For further information on our proposed joint venture with Peabody Energy see Note 6, “Joint Venture with Peabody Energy” to the Consolidated Financial Statements.

Asset impairment and restructuring. During the year ended December 31, 2020, we recorded $208.0 million of impairment charges primarily relating to three of our thermal operations, Coal Creek, West Elk, and Viper, as well as, our equity investment in Knight Hawk Holdings, LLC. Also, during the year ended December 31, 2020, we incurred $13.4 million of restructuring expense related to employee severance from the voluntary separation plans that were accepted by 254 employees of our thermal operations and corporate staff. For further information on our Asset Impairment costs, see Note 5, “Asset Impairment and Restructuring” to the Consolidated Financial Statements.

Gain on property insurance recovery related to Mountain Laurel longwall. In the year ended December 31, 2020 we recorded a $23.5 million benefit from insurance proceeds related to the loss of certain longwall shields at our Mountain Laurel operation. For further information on our gain on property insurance recovery, see Note 7, “Gain on Property Insurance Recovery Related to Mountain Laurel Longwall” to the Consolidated Financial Statements.

Loss (Gain) on Divestitures. During the fourth quarter of 2021, we sold our 49.5% ownership in Knight Hawk Holdings, LLC for $38.0 million. We received $20.5 million during the fourth quarter of 2021 and will receive the remainder in monthly installments through 2024. We recorded a non-cash loss in the amount of $24.2 million during the fourth quarter of 2021. During the year ended December 31, 2020, we recorded a $1.5 million gain on the sale of our Dal-Tex, Briar Branch, and Viper properties. For further information on these gains and losses, see Note 4, “Divestitures” to the Consolidated Financial Statements.

Other operating loss (income), net. The decrease in other operating income, net in the year ended December, 31, 2021 as compared to the year ended December, 31, 2020 results primarily from the net unfavorable impact of certain coal derivative settlements of approximately $36.7 million, partially offset by increased income from equity investments of approximately $7.1 million and an unfavorable impact of mark to market movements on heating oil positions of approximately $1.8 million recorded in the year ended December 31, 2020.

Non-operating expense. The following table summarizes non-operating expense for the years ended December 31, 2021 and 2020:

	Year Ended December 31,		
	2021	2020	Increase (Decrease) in Provision for Net Income Taxes
		(In thousands)	
Non-service related pension and postretirement benefit costs	$ (4,339)	$ (3,884)	$ (455)
Reorganization items, net	—	26	(26)
Total non-operating expenses	$ (4,339)	$ (3,858)	$ (481)

Non-service related pension and postretirement benefit costs. The increase in non-service related pension and postretirement benefit costs in the year ended December 31, 2021 versus the year ended December 31, 2020 is primarily due to increased postretirement benefit loss amortization in the year ended December 31, 2021, partially offset by increased pension settlement recorded in the same year period.

Provision for (benefit from) income taxes. The following table summarizes our provision for income taxes for the years ended December 31, 2021 and 2020:

	Year Ended December 31,		
	2021	2020	Increase (Decrease) in Net Income
		(In thousands)	
Provision for (benefit from) income taxes	$ 1,874	$ (7)	$ (1,881)

See Note 15, to the Consolidated Financial Statements "Taxes," for a reconciliation of the statutory federal income tax provision (benefit) at the statutory rate to the actual benefit from taxes.

Operational Performance

Year Ended December 31, 2021 and 2020

On December 31, 2020, we sold our Viper operation. As a result, we revised our reportable segments beginning in the first quarter of 2021 to better reflect the manner in which the chief operating decision maker (CODM) views our businesses going forward for purposes of reviewing performance, allocating resources and assessing future prospects and strategic execution. Prior to the first quarter of 2021, we had three reportable segments: Metallurgical, Powder River Basin (PRB), and Other Thermal. After the divestment of Viper, we have three remaining active thermal mines: West Elk, Black Thunder, and Coal Creek. With two distinct lines of business, metallurgical and thermal, the movement to two segments better aligns with how we make decisions and allocate resources. No changes were made to the Metallurgical Segment and the three remaining thermal mines have been combined as the "Thermal Segment". The prior periods have been recasted to reflect the change in reportable segments.

Our mining operations are evaluated based on Adjusted EBITDA, per-ton cash operating costs (defined as including all mining costs except depreciation, depletion, amortization, accretion on asset retirements obligations, and pass-through transportation expenses divided by segment tons sold), and on other non-financial measures, such as safety and environmental performance. Adjusted EBITDA is defined as net income (loss) attributable to the Company before the effect of net interest expense, income taxes, depreciation, depletion and amortization, the amortization of sales contracts, the accretion on asset retirement obligations, and non-operating income (expense). Adjusted EBITDA may also be adjusted for items that may not reflect the trend of future results by excluding transactions that are not indicative of our core operating performance. Adjusted EBITDA is not a measure of financial performance in accordance with generally accepted accounting principles, and items excluded from Adjusted EBITDA are significant in understanding and assessing our financial condition. Therefore, Adjusted EBITDA should not be considered in isolation, nor as an alternative to net income (loss), income (loss) from operations, cash flows from operations or as a measure of our profitability, liquidity or performance under generally accepted accounting principles. Furthermore, analogous measures are used by industry analysts to evaluate the Company's operating performance. Investors should be aware that our presentation of Adjusted EBITDA may not be comparable to similarly titled measures used by other companies.

The following table shows operating results of coal operations for the years ended December 31, 2021 and 2020.

	Year Ended December 31, 2021	Year Ended December 31, 2020	Variance
Metallurgical			
Tons sold (in thousands)	7,690	6,979	711
Coal sales per ton sold	$ 126.44	$ 74.17	$ 52.27
Cash cost per ton sold	$ 68.84	$ 61.13	$ (7.71)
Cash margin per ton sold	$ 57.60	$ 13.04	$ 44.56
Adjusted EBITDA (in thousands)	$ 442,830	$ 91,322	$ 351,508
Thermal			
Tons sold (in thousands)	65,280	55,722	9,558
Coal sales per ton sold	$ 13.95	$ 13.55	$ 0.40
Cash cost per ton sold	$ 11.35	$ 13.00	$ 1.65
Cash margin per ton sold	$ 2.60	$ 0.55	$ 2.05
Adjusted EBITDA (in thousands)	$ 175,709	$ 34,035	$ 141,674

This table reflects numbers reported under a basis that differs from U.S. GAAP. See the “Reconciliation of Non-GAAP measures” below for explanation and reconciliation of these amounts to the nearest GAAP figures. Other companies may calculate these per ton amounts differently, and our calculation may not be comparable to other similarly titled measures.

Metallurgical — Adjusted EBITDA for the year ended December 31, 2021 increased from the year ended December 31, 2020 due to increased pricing and increased volume. These benefits were partially offset by increased cash cost of sales per ton sold. The improvement in the current year over the prior year is largely due to the difference in trajectory of the COVID-19 pandemic during the respective periods in time. During 2021, increasing vaccine availability and generally decreasing restrictions led to accelerating economic growth, and increasing steel demand and pricing, improving prompt coking coal index prices. In contrast, during 2020, coking coal prices fell as large-scale industrial shutdowns were initiated in response to the emergence of COVID-19. Particularly, in the second half of 2021, surging coking coal demand, largely from Asia, and supply constrained by various disruptions, led to historically high pricing across all coking coal indices. The increase in cash cost per ton sold is primarily due to increased taxes and royalties that are based on a percentage of coal sales per ton sold, and the expected ramp up of production levels at our new Leer South longwall.

During the end of the third quarter of 2021, we completed our Leer South longwall development, and initiated longwall production in late August of 2021. The ramp up to planned production levels is ongoing, and productivity continued to increase over the course of the fourth quarter of 2021. We expect to achieve planned long-term productivity levels by the second quarter of 2022. The addition of this second longwall operation to our Metallurgical Segment is expected to significantly increase our future volumes and strengthen our low average segment cost structure relative to our peers.

Our Metallurgical segment sold 7.0 million tons of coking coal and 0.7 million tons of associated thermal coal in the year ended December 31, 2021, compared to 6.0 million tons of coking coal and 1.0 million tons of associated thermal coal in the year ended December 31, 2020. Longwall operations accounted for approximately 71% of our shipment volume in the year ended December 31, 2021, compared to approximately 60% of our shipment volume in the year ended December 31, 2020.

Thermal — Adjusted EBITDA for the year ended December 31, 2021 increased versus the year ended December 31, 2020, due to increased sales volume, increased coal sales per ton sold, and decreased cash cost per ton sold. The improvement in sales volume in the current year over the prior year is primarily due to increased domestic utility coal burn, resulting from higher natural gas pricing and improved economic growth. Sales volume also benefitted from increased thermal exports, which more than tripled over the prior year to approximately 2.2 million tons. The increase in coal sales per ton sold reflects higher realized prices at all of our thermal operations, and the reduction in

cash cost per ton sold is driven by both the increase in sales volume and the increased percentage of volume from our lower cost Black Thunder operation. Our cash cost per ton sold benefited from our operational flexibility to take advantage of increasing demand, despite the substantial progress we have made in our efforts to align production levels with the secular decline in domestic thermal coal demand. Also, contributing to the decreases in cost is the inclusion of approximately 0.9 million tons sold from our former Viper operation in the year ended December 31, 2020. During 2021, we completed approximately $33.5 million of ARO work at our current Thermal Segment operations primarily in the Powder River Basin, compared to $6.8 million during 2020.

On December 31, 2020, we sold our Other Thermal operation, Viper, to Knight Hawk Holdings, LLC. For further information on the sale of Viper, please see Note 4, “Divestitures” to the Consolidated Financial Statements.

Reconciliation of NON-GAAP measures

Non-GAAP Segment coal sales per ton sold

Non-GAAP Segment coal sales per ton sold is calculated as segment coal sales revenues divided by segment tons sold. Segment coal sales revenues are adjusted for transportation costs, and may be adjusted for other items that, due to generally accepted accounting principles, are classified in “other income” on the consolidated income statements, but relate to price protection on the sale of coal. Segment coal sales per ton sold is not a measure of financial performance in accordance with generally accepted accounting principles. We believe segment coal sales per ton sold provides useful information to investors as it better reflects our revenue for the quality of coal sold and our operating results by including all income from coal sales. The adjustments made to arrive at these measures are significant in understanding and assessing our financial condition. Therefore, segment coal sales revenues should not be considered in isolation, nor as an alternative to coal sales revenues under generally accepted accounting principles.

Year Ended December 31, 2021 (In thousands)	Metallurgical	Thermal	Idle and Other	Consolidated
GAAP Revenues in the Consolidated Statements of Operations	$ 1,149,132	$ 1,057,481	$ 1,429	$ 2,208,042
Less: Adjustments to reconcile to Non-GAAP Segment coal sales revenue				
Coal risk management derivative settlements classified in "other income"	(1,192)	28,656	—	27,464
Coal sales revenues from idled or otherwise disposed operations not included in segments	—	—	1,424	1,424
Transportation costs	177,917	118,270	5	296,192
Non-GAAP Segment coal sales revenues	$ 972,407	$ 910,555	$ —	$ 1,882,962
Tons sold	7,690	65,280		
Coal sales per ton sold	$ 126.44	$ 13.95		

Year Ended December 31, 2020 (In thousands)	Metallurgical	Thermal	Idle and Other	Consolidated
GAAP Revenues in the Consolidated Statements of Operations	$ 641,536	$ 801,632	$ 24,424	$ 1,467,592
Less: Adjustments to reconcile to Non-GAAP Segment coal sales revenue				
Coal risk management derivative settlements classified in "other income"	(577)	(8,632)	—	(9,209)
Coal sales revenues from idled or otherwise disposed operations not included in segments	—	—	24,322	24,322
Transportation costs	124,494	55,477	102	180,073
Non-GAAP Segment coal sales revenues	$ 517,619	$ 754,787	$ —	$ 1,272,406
Tons sold	6,979	55,722		
Coal sales per ton sold	$ 74.17	$ 13.55		

Non-GAAP Segment cash cost per ton sold

Non-GAAP Segment cash cost per ton sold is calculated as segment cash cost of coal sales divided by segment tons sold. Segment cash cost of coal sales is adjusted for transportation costs, and may be adjusted for other items that, due to generally accepted accounting principles, are classified in "other income" on the consolidated income statements, but relate directly to the costs incurred to produce coal. Segment cash cost per ton sold is not a measure of financial performance in accordance with generally accepted accounting principles. We believe segment cash cost per ton sold better reflects our controllable costs and our operating results by including all costs incurred to produce coal. The adjustments made to arrive at these measures are significant in understanding and assessing our financial condition. Therefore, segment cash cost of coal sales should not be considered in isolation, nor as an alternative to cost of sales under generally accepted accounting principles.

Year Ended December 31, 2021 **(In thousands)**	**Metallurgical**	**Thermal**	**Idle and Other**	**Consolidated**
GAAP Cost of sales in the Consolidated Statements of Operations	$ 707,312	$ 859,070	$ 13,454	$ 1,579,836
Less: Adjustments to reconcile to Non-GAAP Segment cash cost of coal sales				
Transportation costs	177,917	118,270	5	296,192
Cost of coal sales from idled or otherwise disposed operations not included in segments	—	—	5,838	5,838
Other (operating overhead, certain actuarial, etc.)	—	—	7,611	7,611
Non-GAAP Segment cash cost of coal sales	$ 529,395	$ 740,800	$ —	$ 1,270,195
Tons sold	7,690	65,280		
Cash Cost Per Ton Sold	$ 68.84	$ 11.35		

Year Ended December 31, 2020 **(In thousands)**	**Metallurgical**	**Thermal**	**Idle and Other**	**Consolidated**
GAAP Cost of sales in the Consolidated Statements of Operations	$ 551,133	$ 778,267	$ 49,079	$ 1,378,479
Less: Adjustments to reconcile to Non-GAAP Segment cash cost of coal sales				
Diesel fuel risk management derivative settlements classified in "other income"	—	(1,788)	—	(1,788)
Transportation costs	124,494	55,477	102	180,073
Cost of coal sales from idled or otherwise disposed operations not included in segments	—	—	41,322	41,322
Other (operating overhead, certain actuarial, etc.)	—	—	7,655	7,655
Non-GAAP Segment cash cost of coal sales	$ 426,639	$ 724,578	$ —	$ 1,151,217
Tons sold	6,979	55,722		
Cash Cost Per Ton Sold	$ 61.13	$ 13.00		

Reconciliation of Segment Adjusted EBITDA to Net Income (loss)

The discussion in "Results of Operations" above includes references to our Adjusted EBITDA for each of our reportable segments. Adjusted EBITDA is defined as net income (loss) attributable to the Company before the effect of net interest expense, income taxes, depreciation, depletion and amortization, the amortization of sales contracts, and the accretion on asset retirement obligations. Adjusted EBITDA may also be adjusted for items that may not reflect the trend of future results by excluding transactions that are not indicative of our core operating performance. We use Adjusted EBITDA to measure the operating performance of our segments and allocate resources to our segments. Adjusted EBITDA is not a measure of financial performance in accordance with generally accepted accounting principles, and items excluded from Adjusted EBITDA are significant in understanding and assessing our financial condition. Therefore, Adjusted EBITDA should not be considered in isolation, nor as an alternative to net income (loss), income (loss) from operations, cash flows from operations or as a measure of our profitability, liquidity or performance under generally accepted accounting principles. Investors should be aware that our presentation of Adjusted EBITDA may not be comparable to similarly titled measures used by other companies. The table below shows how we calculate Adjusted EBITDA.

	Year Ended December 31, 2021	Year Ended December 31, 2020
Net income (loss)	$ 337,573	$ (344,615)
Provision for (benefit from) income taxes	1,874	(7)
Interest expense, net	23,344	10,624
Depreciation, depletion and amortization	120,327	121,552
Accretion on asset retirement obligations	21,748	19,887
Costs related to proposed joint venture with Peabody Energy	—	16,087
Asset impairment and restructuring	—	221,380
Gain on property insurance recovery related to Mountain Laurel longwall	—	(23,518)
Loss (Gain) on divestitures	24,225	(1,505)
Preference Rights Lease Application settlement income	—	—
Non-service related pension and postretirement benefit costs	4,339	3,884
Reorganization items, net	—	(26)
Adjusted EBITDA	533,430	23,743
EBITDA from idled or otherwise disposed operations	2,469	15,858
Selling, general and administrative expenses	92,342	82,397
Other	(9,702)	3,359
Segment Adjusted EBITDA from coal operations	$ 618,539	$ 125,357

Other includes primarily income from our equity investments, certain changes in the fair value of coal derivatives and coal trading activities, certain changes in fair value of heating oil derivatives we use to manage our exposure to diesel fuel pricing, net EBITDA provided by our land company, and certain miscellaneous revenue.

For the year ended December 31, 2021, amounts included in Other increased Adjusted EBITDA by approximately $9.7 million versus decreasing Adjusted EBITDA approximately $3.4 million in the year ended December 31, 2020. The net increase in Adjusted EBITDA from Other was primarily related to favorable change in value of coal derivatives of approximately $7.7 million, and increased income from equity investments of approximately $7.1 million.

Liquidity and Capital Resources

Our primary sources of liquidity are proceeds from coal sales to customers and certain financing arrangements. Excluding significant investing activity, we intend to satisfy our working capital requirements and fund capital expenditures and debt-service obligations with cash generated from operations and cash on hand. We remain focused on prudently managing costs, including capital expenditures, maintaining a strong balance sheet, and ensuring adequate liquidity.

Given the volatile nature of coal markets, and the significant challenges and uncertainty surrounding the COVID-19 pandemic, we believe it remains important to take a prudent approach to managing our balance sheet and liquidity. Additionally, banks and other lenders have become increasingly unwilling to provide financing to coal producers, especially those with significant thermal coal exposure. Due to the nature of our business, we may be limited in accessing debt capital markets or obtaining additional bank financing, or the cost of accessing this financing could become more expensive.

With the completion of the Leer South development, our capital spending returned to maintenance levels in the fourth quarter of 2021, and we expect our capital spending to remain at maintenance levels for the foreseeable future. In light of the reduced capital requirements and current favorable pricing environment, we generated significant cash flows in the fourth quarter of 2021 and expect cash flows to remain strong in 2022. Our priority is to improve our financial position, through enhancing liquidity and reducing our debt and other liabilities. During the fourth quarter of 2021, our cash balance increased $129.9 million and we ended the year with cash of $339.7 million and total liquidity of $389.9 million. Also, during the fourth quarter, we made an initial deposit of $20.0 million into a fund to pay for future ARO costs at our legacy thermal operations, primarily in the Powder River Basin, and repurchased $5.0 million of our term loan at a slight discount. We believe our current liquidity level is sufficient to fund our business and meet both our short-term (next twelve months) and reasonably foreseeable long-term requirements and obligations, especially in light of reduced capital spending requirements. In 2022, we have continued to reduce debt by repaying an additional $271.3 million of our term loan throughout January and the first half of February. Additionally, during 2022, we plan to make contributions to the thermal ARO fund on a quarterly basis and expect total contributions could be at least $100.0 million if market conditions remain favorable.

On March 7, 2017, we entered into a senior secured term loan credit agreement in an aggregate principal amount of $300 million (the “Term Loan Debt Facility”) with Credit Suisse AG, Cayman Islands Branch, as administrative agent and collateral agent and the other financial institutions from time to time party thereto. The Term Loan Debt Facility was issued at 99.50% of the face amount and will mature on March 7, 2024. The term loans provided under the Term Loan Debt Facility (the “Term Loans”) are subject to quarterly principal amortization payments in an amount equal to $0.8 million. Proceeds from the Term Loan Debt Facility were used to repay all outstanding obligations under our previously existing term loan credit agreement, dated as of October 5, 2016. The interest rate on the Term Loan is, at our option, either (i) the London interbank offered rate (“LIBOR”) plus an applicable margin of 2.75%, subject to a 1.00% LIBOR floor, or (ii) a base rate plus an applicable margin of 1.75%. For further information regarding the Term Loan Debt Facility, see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

We have entered into a series of interest rate swaps to fix a portion of the LIBOR interest payments due under the term loan. As interest payments are made on the term loan, amounts in accumulated other comprehensive income will be reclassified into earnings through interest expense to reflect a net interest on the term loan equal to the effective yield of the fixed rate of the swap plus 2.75% which is the spread on the LIBOR term loan as amended. For further information regarding the interest rate swaps see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

On September 30, 2020, we extended and amended our existing trade accounts receivable securitization facility provided to Arch Receivable Company, LLC, a special-purpose entity that is a wholly owned subsidiary of Arch Resources (“Arch Receivable”) (the “Securitization Facility”), which supports the issuance of letters of credit and requests for cash advances. The amendment to the Securitization Facility reduced the facility size from $160 million to

$110 million and extended the maturity date to September 29, 2023. For further information regarding the Securitization Facility see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

On September 30, 2020, we amended the senior secured inventory-based revolving credit facility in an aggregate principal amount of $50 million (the “Inventory Facility”) with Regions Bank (“Regions”) as administrative agent and collateral agent, as lender and swingline lender (in such capacities, the “Lender”) and as letter of credit issuer. Availability under the Inventory Facility is subject to a borrowing base consisting of (i) 85% of the net orderly liquidation value of eligible coal inventory, plus (ii) the lesser of (x) 85% of the net orderly liquidation value of eligible parts and supplies inventory and (y) 35% of the amount determined pursuant to clause (i), plus (iii) 100% of our Eligible Cash (defined in the Inventory Facility), subject to reduction for reserves imposed by Regions. The amendment of the Inventory Facility extended the maturity date to September 29, 2023, eliminated the provision that accelerated maturity of the facility upon falling below a specified level of liquidity, and reduced the minimum liquidity requirement from $175 million to $100 million. Additionally, the amendment includes provisions that reduce the advance rates for coal inventory and parts and supplies, depending on liquidity. For further information regarding the Inventory Facility, see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

On July 2, 2020, the West Virginia Economic Development Authority (the “Issuer”) issued $53.1 million aggregate principal amount of Solid Waste Disposal Facility Revenue Bonds (Arch Resources Project), Series 2020 (the “2020 Tax Exempt Bonds”) pursuant to an Indenture of Trust dated as of June 1, 2020 (the “Indenture of Trust”) between the Issuer and Citibank, N.A., as trustee (the “Trustee”). As a follow-on to our $53.1 million offering, on March 4, 2021, the Issuer issued an additional $45.0 million in Series 2021 Tax Exempt Bonds (the “2021 Tax Exempt Bonds” and together with the 2020 Tax Exempt Bonds, the “Tax Exempt Bonds”). The proceeds of the Tax Exempt Bonds were loaned to us as we made qualifying expenditures pursuant to a Loan Agreement dated as of June 1, 2020, as supplemented by a First Amendment to the Loan Agreement dated March 1, 2021 (collectively, the “Loan Agreement”), each between the Issuer and us. The Tax Exempt Bonds are payable solely from payments to be made by us under the Loan Agreement as evidenced by Notes from us to the Trustee. The proceeds of the Tax Exempt Bonds were used to finance certain costs of the acquisition, construction, reconstruction, and equipping of solid waste disposal facilities at our Leer South development, and for capitalized interest and certain costs related to the issuance of the Tax Exempt Bonds. As of December 31, 2021, we have utilized the total Tax Exempt Bond proceeds. For further information regarding the Tax Exempt Bonds, see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

In November, 2020, we issued $155.3 million in aggregate principal amount of 5.25% convertible senior notes due 2025 (“Convertible Notes” or “Convertible Debt”). The net proceeds from the issuance of the Convertible Notes, after deducting offering related costs of $5.1 million and the cost of a capped call transaction of $17.5 million, were approximately $132.7 million. The Convertible Notes bear interest at the annual rate of 5.25%, payable semiannually in arrears on May 15 and November 15 of each year, and will mature on November 15, 2025, unless earlier converted, redeemed or repurchased by us. For further information regarding the Convertible Debt, see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

During the fourth quarter of 2021, the common stock price condition of the Convertible Notes was satisfied, as the closing stock price exceeded 130% of the conversion price of approximately $37.208 for at least 20 trading days of the last 30 trading days prior to quarter end. As a result, the Convertible Notes are convertible at the election of the noteholders during the first quarter of 2022, and due to our stated intent to settle the principal value in cash, the liability portion of $121.6 million of the Convertible Notes is included in current maturities of debt on our Consolidated Balance Sheet at December 31, 2021. As of the date of this Annual Report on Form 10-K, we have not received any conversion requests for the Convertible Notes and do not anticipate receiving any conversion requests, as the market value of the Convertible Notes exceeds the conversion value of the Convertible Notes. As of December 31, 2021, the if-converted value of the Convertible Notes exceeded the principal amount by $225.3 million. For further information regarding the Convertible Notes and the capped call transactions, see Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements.

On April 27, 2017, our Board of Directors authorized a capital return program consisting of a share repurchase program and a quarterly cash dividend. The share repurchase plan has a total authorization of $1.05 billion of which we

have used $827.4 million. During the year ended December 31, 2021, we did not repurchase any shares of our stock. On April 23, 2020, we announced the suspension of our quarterly dividend due to the significant economic uncertainty surrounding the COVID-19 pandemic and the steps being taken to control the virus. On October 26, 2021, as a result of improved liquidity, we announced the initiation of a $0.25 per share quarterly dividend. Through the addition of Leer South, we believe we have significantly increased our future cash-generating capabilities and as a result we plan to launch an adjusted and more comprehensive capital return program in the second quarter of 2022. We plan to return to stockholders approximately 50% of the prior quarter's discretionary cash flow via a variable rate quarterly cash dividend that will complement our existing fixed rate cash dividend of $0.25 per share, and to use the remaining 50% of our discretionary cash flow for potential share buybacks, special dividends, the repurchase of potentially dilutive securities, and capital preservation. All of these potential uses of capital are subject to board approval and declaration. Any shares acquired would be in the open market or through private transactions in accordance with Securities and Exchange Commission requirements.

On December 31, 2021, we had total liquidity of approximately $389.9 million including $339.7 million in unrestricted cash and equivalents, and short-term investments in debt securities, with the remainder provided by availability under our credit facilities, and funds withdrawable from brokerage accounts. The table below summarizes our availability under our credit facilities as of December 31, 2021:

	Face Amount	Borrowing Base	Letters of Credit Outstanding	Availability	Contractual Expiration
			(Dollars in thousands)		
Securitization Facility	$ 110,000	$ 110,000	$ 67,483	$ 42,517	September 29, 2023
Inventory Facility	50,000	34,111	27,712	6,399	September 29, 2023
Total	$ 160,000	$ 144,111	$ 95,195	$ 48,916	

The above standby letters of credit outstanding have primarily been issued to satisfy certain insurance-related collateral requirements. The amount of collateral required by counterparties is based on their assessment of our ability to satisfy our obligations and may change at the time of policy renewal or based on a change in their assessment. Future increases in the amount of collateral required by counterparties would reduce our available liquidity.

Contractual Obligations

The table below summarizes our contractual obligations as of December 31, 2021:

	Payments Due by Period				
	2022	2023-2024	2025-2026	after 2026	Total
			(Dollars in thousands)		
Long-term debt, including related interest	$ 133,624	$ 279,017	$ 267,075	$ —	$ 679,716
Leases	4,599	8,976	8,376	1,533	23,484
Coal lease rights	3,248	6,082	5,037	37,009	51,376
Coal purchase obligations	3,336	—	—	—	3,336
Unconditional purchase obligations	129,351	—	—	—	129,351
Total contractual obligations	$ 274,158	$ 294,075	$ 280,488	$ 38,542	$ 887,263

The related interest on long-term debt was calculated using rates in effect at December 31, 2021, for the remaining term of outstanding borrowings. In 2022, we have continued to reduce debt by repaying an additional $271.3 million of our term loan throughout January and the first half of February.

Coal lease rights represent non-cancelable royalty lease agreements, as well as lease bonus payments due.

Unconditional purchase obligations include open purchase orders and other purchase commitments, which have not been recognized as a liability. The commitments in the table above relate to contractual commitments for the purchase of materials and supplies, payments for services and capital expenditures.

The table above excludes our asset retirement obligations. Our consolidated balance sheet reflects a liability of $214.5 million including amounts classified as a current liability for asset retirement obligations that arise from SMCRA and similar state statutes, which require that mine property be restored in accordance with specified standards and an approved reclamation plan. Asset retirement obligations are recorded at fair value when incurred and accretion expense is recognized through the expected date of settlement. Determining the fair value of asset retirement obligations involves a number of estimates, as discussed in the section entitled “Critical Accounting Estimates” below, including the timing of payments to satisfy the obligations. The timing of payments to satisfy asset retirement obligations is based on numerous factors, including mine closure dates. Please see Note 16, “Asset Retirement Obligations” to our Consolidated Financial Statements for further information about our asset retirement obligations.

The table above also excludes certain other obligations reflected in our consolidated balance sheet, including estimated funding for pension and postretirement benefit plans and worker’s compensation obligations. The timing of contributions to our pension plans varies based on a number of factors, including changes in the fair value of plan assets and actuarial assumptions. Please see the section entitled “Critical Accounting Estimates” below for more information about these assumptions. We expect to make no contributions to our pension plans in 2022.

Please see Note 20, “Workers’ Compensation Expense”, and Note 21, “Employee Benefit Plans” to our Consolidated Financial Statements for more information about the amounts we have recorded for workers’ compensation and pension and postretirement benefit obligations, respectively.

Off-Balance Sheet Arrangements

In the normal course of business, we are a party to certain off-balance sheet arrangements. These arrangements include guarantees, indemnifications, financial instruments with off-balance sheet risk, such as bank letters of credit and performance or surety bonds. Liabilities related to these arrangements are not reflected in our consolidated balance sheets, and we do not expect any material adverse effects on our financial condition, results of operations or cash flows to result from these off-balance sheet arrangements.

We use a combination of surety bonds and letters of credit to secure our financial obligations for reclamation, workers’ compensation, coal lease obligations and other obligations as follows as of December 31, 2021:

	Reclamation Obligations	Lease Obligations	Workers’ Compensation Obligations	Other	Total
			(Dollars in thousands)		
Surety bonds	$ 500,486	$ 26,013	$ 50,028	$ 7,530	$ 584,057
Letters of credit	20,000	—	65,683	1,354	87,037

Cash Flow

The following is a summary of cash provided by or used in each of the indicated types of activities during the year ended December 31, 2021 and 2020:

	Year Ended December 31,	
	2021	2020
(In thousands)		
Cash provided by (used in):		
Operating activities	$ 238,284	$ 61,106
Investing activities	(141,215)	(226,009)
Financing activities	35,781	205,328

Cash provided by operating activities increased in the year ended December 31, 2021 versus the year ended December 31, 2020 mainly due to the improvement in results from operations discussed in the “Overview” and “Operational Performance” sections above, partially offset by a greater increase in working capital requirements of

approximately $207 million, primarily in receivables; receipt of an approximately $38 million income tax refund in the prior year period; an increase in reclamation work completed of approximately $25 million; and the establishment and funding of a fund for asset retirement obligations of approximately $20 million in the current year period.

Cash used in investing activities decreased in the year ended December 31, 2021 versus the year ended December 31, 2020 primarily due to an approximately $49 million increase in net proceeds from short term investments; decreased capital expenditures of approximately $40 million, as the Leer South mine completed development; and an approximately $20 million increase from proceeds of disposals and divestitures, mainly proceeds from the divestiture of Knight Hawk Holdings; which were partially offset by an approximately $24 million in property insurance proceeds on our Mountain Laurel longwall claim in the prior year period.

Cash provided by financing activities decreased in the year ended December 31, 2021 versus the year ended December 31, 2020 primarily due to the net proceeds of approximately $138 million from issuance of the Convertible Notes in the prior year period; a net decrease in proceeds from Equipment Financing transactions of approximately $34 million; and a net decrease in proceeds from the issuance of our Tax Exempt Bonds of approximately $8 million; which were partially offset by a decrease in debt financing costs of approximately $8 million; and a decrease in dividends paid of approximately $4 million.

Critical Accounting Estimates

We prepare our financial statements in accordance with accounting principles that are generally accepted in the United States. The preparation of these financial statements requires management to make estimates and judgments that affect the reported amounts of assets, liabilities, revenues and expenses as well as the disclosure of contingent assets and liabilities. Management bases our estimates and judgments on historical experience and other factors that are believed to be reasonable under the circumstances. Additionally, these estimates and judgments are discussed with our audit committee on a periodic basis. Actual results may differ from the estimates used under different assumptions or conditions. We have provided a description of all significant accounting policies in the notes to our Consolidated Financial Statements. We believe that of these significant accounting policies, the following may involve a significant level of estimation uncertainty and have had or are reasonably likely to have a material impact on our financial condition or results of operations:

Derivative Financial Instruments

We utilize derivative instruments to manage exposures to commodity prices and interest rate risk on long-term debt. Additionally, we may hold certain coal derivative instruments for trading purposes. Derivative financial instruments are recognized in the balance sheet at fair value. Certain coal contracts may meet the definition of a derivative instrument, but because they provide for the physical purchase or sale of coal in quantities expected to be used or sold by us over a reasonable period in the normal course of business, they are not recognized on the balance sheet and changes in the fair value of the derivative instrument are recorded in the consolidated statements of operations.

Certain derivative instruments are designated as the hedge instrument in a hedging relationship. In a cash flow hedge, we hedge the risk of changes in future cash flows related to the underlying item being hedged. Changes in the fair value of the derivative instrument used as a hedge instrument in a cash flow hedge are recorded in other comprehensive income. Amounts in other comprehensive income are reclassified to earnings when the hedged transaction affects earnings and are classified in a manner consistent with the transaction being hedged.

We formally document all relationships between hedging instruments and hedged items, as well as our risk management objectives for undertaking various hedge transactions. We evaluate the effectiveness of our hedging relationships both at the hedge inception and on an ongoing basis.

See Note 12 to the Consolidated Financial Statements, “Derivatives” for further disclosures related to the Company’s derivative instruments.

Impairment of Long-lived Assets

We review our long-lived assets for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. These events and circumstances include, but are not limited to, a current expectation that a long-lived asset will be disposed of significantly before the end of its previously estimated useful life, a significant adverse change in the extent or manner in which we use a long-lived asset or a change in its physical condition.

When such events or changes in circumstances occur, a recoverability test is performed comparing projected undiscounted cash flows from the use and eventual disposition of an asset or asset group to its carrying amount. If the projected undiscounted cash flows are less than the carrying amount, an impairment is recorded for the excess of the carrying amount over the estimate fair value, which is generally determined using discounted future cash flows. If we recognize an impairment loss, the adjusted carrying amount of the asset becomes the new cost basis. For a depreciable long-lived asset, the new cost basis will be depreciated (amortized) over the remaining estimated useful life of the asset.

We make various assumptions, including assumptions regarding future cash flows in our assessments of long-lived assets for impairment. The assumptions about future cash flows and growth rates are based on the current and long-term business plans related to the long-lived assets. Discount rate assumptions are based on an assessment of the risk inherent in the future cash flows of the long-lived assets. These assumptions require significant judgments on our part, and the conclusions that we reach could vary significantly based upon these judgments.

During the year ended December, 31, 2020, we determined that we had indicators of impairment related to three of our thermal operations, Coal Creek, West Elk, and Viper, as well as, our equity investment in Knight Hawk Holdings, LLC. Our analyses of future expected cash flows from these assets indicated full impairment of our listed thermal operations and partial impairment of our equity investment in Knight Hawk Holdings, LLC. As of December 31, 2021, there were no indicators of impairment identified.

Please see the Note 5, “Asset impairment and restructuring” to our Consolidated Financial Statements for more information about the amounts we have recorded for Asset Impairment.

Asset Retirement Obligations

Our asset retirement obligations arise from SMCRA and similar state statutes, which require that mine property be restored in accordance with specified standards and an approved reclamation plan. Significant reclamation activities include reclaiming refuse and slurry ponds, reclaiming the pit and support acreage at surface mines, and sealing portals at deep mines. Our asset retirement obligations are initially recorded at fair value, or the amount at which the obligations could be settled in a current transaction between willing parties. This involves determining the present value of estimated future cash flows on a mine-by-mine basis based upon current permit requirements and various estimates and assumptions, including estimates of disturbed acreage, reclamation costs and assumptions regarding equipment productivity. We estimate disturbed acreage based on approved mining plans and related engineering data. Since we plan to use internal resources to perform the majority of our reclamation activities, our estimate of reclamation costs involves estimating third-party profit margins, which we base on our historical experience with contractors that perform certain types of reclamation activities. We base productivity assumptions on historical experience with the equipment that we expect to utilize in the reclamation activities. In order to determine fair value, we discount our estimates of cash flows to their present value. We base our discount rate on the rates of treasury bonds with maturities similar to expected mine lives, adjusted for our credit standing.

Accretion expense is recognized on the obligation through the expected settlement date. On at least an annual basis, we review our entire reclamation liability and make necessary adjustments for permit changes as granted by state authorities, changes in the timing and extent of reclamation activities, and revisions to cost estimates and productivity assumptions, to reflect current experience. Any difference between the recorded amount of the liability and the actual cost of reclamation will be recognized as a gain or loss when the obligation is settled. We expect our actual cost to reclaim our properties will be less than the expected cash flows used to determine the asset retirement obligation. At December 31, 2021, our balance sheet reflected asset retirement obligation liabilities of $214.5 million, including

amounts classified as a current liability. As of December 31, 2021, we estimate the aggregate uninflated and undiscounted cost of final mine closures to be approximately $346.0 million.

See the roll forward of the asset retirement obligation liability in Note 16, “Asset Retirement Obligations” to the Consolidated Financial Statements.

Employee Benefit Plans

We have non-contributory defined benefit pension plans covering certain of our salaried and hourly employees. Benefits are generally based on the employee’s years of service and compensation. The actuarially-determined funded status of the defined benefit plans is reflected in the balance sheet.

The calculation of our net periodic benefit costs (pension expense) and benefit obligation (pension liability) associated with our defined benefit pension plan requires the use of a number of assumptions. These assumptions are summarized in Note 21, “Employee Benefit Plans”, to the Consolidated Financial Statements. Changes in these assumptions can result in different pension expense and liability amounts, and actual experience can differ from the assumptions.

- The expected long-term rate of return on plan assets is an assumption reflecting the average rate of earnings expected on the funds invested or to be invested to provide for the benefits included in the projected benefit obligation. We establish the expected long-term rate of return at the beginning of each fiscal year based upon historical returns and projected returns on the underlying mix of invested assets. The pension plan’s investment targets are 15% equity and 85% fixed income securities. Investments are rebalanced on a periodic basis to approximate these targeted guidelines. The long-term rate of return assumptions are less than the plan’s actual life-to-date returns.

- The discount rate represents our estimate of the interest rate at which pension benefits could be effectively settled. Assumed discount rates are used in the measurement of the projected, accumulated and vested benefit obligations and the service and interest cost components of the net periodic pension cost. The determination of the discount rate was updated from our actuary’s proprietary Yield Curve model, under which the expected benefit payments of the plan are matched against a series of spot rates from a market basket of high quality fixed income securities.

The differences generated from changes in assumed discount rates and returns on plan assets are amortized into earnings using the corridor method, whereby the unrecognized (gains)/losses in excess of 10% of the greater of the beginning of the year projected benefit obligation or market-related value of assets are amortized over the average remaining life expectancy of the plan participants.

We also currently provide certain postretirement medical and life insurance coverage for eligible employees. Generally, covered employees who terminate employment after meeting eligibility requirements are eligible for postretirement coverage for themselves and their dependents. The salaried employee postretirement benefit plans are contributory, with retiree contributions adjusted periodically, and contain other cost-sharing features such as deductibles and coinsurance.

Actuarial assumptions are required to determine the amounts reported as obligations and costs related to the postretirement benefit plan. The discount rate assumption reflects the rates available on high-quality fixed-income debt instruments at year-end and is calculated in the same manner as discussed above for the pension plan.

Income Taxes

We provide for deferred income taxes for temporary differences arising from differences between the financial statement and tax basis of assets and liabilities existing at each balance sheet date using enacted tax rates expected to be in effect when the related taxes are expected to be paid or recovered. We initially recognize the effects of a tax position when it is more than 50% likely, based on the technical merits, that that position will be sustained upon examination, including resolution of the related appeals or litigation processes, if any. Our determination of whether or not a tax position has met the recognition threshold considers the facts, circumstances, and information available at the reporting date.

On the basis of this evaluation, a full valuation allowance has been in place against the Company's net deferred tax assets since 2015. Through December 31, 2018, the Company was in a cumulative loss position. Since 2019, the Company has been in a cumulative income position, however, the Company has fluctuated between income and loss for individual years and quarters within each cumulative three-year period.

We utilize three years of pre-tax income or loss to measure of our cumulative results in recent years. A valuation allowance is difficult to avoid when a company is in a cumulative loss position, as it constitutes significant negative evidence with regards to future taxable income. However, a cumulative loss is not solely determinative of the need for a valuation allowance. The Company considers all other positive and negative evidence available as part of its assessment of the need for a valuation allowance, including but not limited to future taxable income, available tax planning strategies and the reversal of temporary differences.

See Note 15 to the Consolidated Financial Statements, "Taxes" for further disclosures about income taxes.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK.

We manage our commodity price risk for our non-trading, thermal coal sales through the use of long-term coal supply agreements, and to a limited extent, through the use of derivative instruments. Sales commitments in the metallurgical coal market are typically not long-term in nature, and we are therefore subject to fluctuations in market pricing.

Our commitments for 2022 are as follows:

	2022	
	Tons	$per ton
	(in millions)	
Metallurgical		
Committed, North America Priced Coking	0.3	$ 201.56
Committed, North America Unpriced Coking	0.2	
Committed, Seaborne Priced Coking	0.4	134.17
Committed, Seaborne Unpriced Coking	3.0	
Committed, Priced Thermal	0.3	24.85
Committed, Unpriced Thermal	0.1	
Thermal		
Committed, Priced	75.4	$ 17.17
Committed, Unpriced	3.4	

We have exposure to price risk for supplies that are used directly or indirectly in the normal course of production, such as diesel fuel, steel, explosives and other items. We manage our risk for these items through strategic sourcing contracts in normal quantities with our suppliers. We may sell or purchase forward contracts, swaps and options in the over-the-counter market in order to manage our exposure to price risk related to these items.

We are exposed to price risk with respect to diesel fuel purchased for use in our operations. We anticipate purchasing approximately 40 to 45 million gallons of diesel fuel for use in our operations during 2022. To protect the our cash flows from increases in the price of diesel fuel, we purchased heating oil call options. At December 31, 2021, we had protected the price of expected diesel fuel purchases for 2022 with approximately 8 million gallons of heating oil call options with an average strike price of $2.38 per gallon. These positions are not designated as hedges for accounting purposes, and therefore, changes in the fair value are recorded immediately to earnings.

We are exposed to market risk associated with interest rates due to our existing level of indebtedness. At December 31, 2021, of our $605.1 million principal amount of debt outstanding, approximately $280.9 million of outstanding borrowings have interest rates that fluctuate based on changes in the market rates. An increase in the interest rates related to these borrowings of 25 basis points would not result in a material annualized increase in interest expense based on interest rates in effect at December 31, 2021, because we have fixed a portion of the LIBOR portion of the interest rate on our term loan using interest rate swaps. As of December 31, 2021, the LIBOR rate was well below the 1% floor established in our term loan agreement. See Note 14, “Debt and Financing Arrangements” to the Consolidated Financial Statements for additional information on the interest rate swaps.

ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA.

The Consolidated Financial Statements and consolidated financial statement schedule of Arch Resources, Inc. and subsidiaries are included in this Annual Report on Form 10-K beginning on page F-1.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE.

None.

ITEM 9A. CONTROLS AND PROCEDURES.

We performed an evaluation under the supervision and with the participation of our management, including our chief executive officer and chief financial officer, of the effectiveness of the design and operation of our disclosure controls and procedures as of December 31, 2021, as defined in Rules 13a-15(e) and 15d-15(e) under the Securities Exchange Act of 1934, as amended. Based on that evaluation, our management, including our chief executive officer and chief financial officer, concluded that the disclosure controls and procedures were effective as of such date. There were no changes in our internal control over financial reporting during the fiscal quarter ended December 31, 2021 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

We incorporate by reference the opinion of independent registered public accounting firm and management's report on internal control over financial reporting included within the Financial Statement section of this Annual Report on Form 10-K.

ITEM 9B. OTHER INFORMATION.

None.

ITEM 9C. DISCLOSURE REGARDING FOREIGN JURISDICTIONS THAT PREVENT INSPECTIONS.ER INFORMATION.

Not applicable

PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE.

Except for the disclosures contained in Part I of this report under the caption “Information about our Executive Officers,” the information required under this item is incorporated herein by reference to “Director Biographies,” “Corporate Governance Practices” and, if applicable, “Delinquent Section 16(a) Reports” in our Proxy Statement for the 2022 Annual Meeting of Stockholders, which is expected to be filed with the SEC within 120 days after the close of our fiscal year.

ITEM 11. EXECUTIVE COMPENSATION.

The information required under this item is incorporated herein by reference to “Executive Compensation,” “Director Compensation,” “Compensation Committee Interlocks and Insider Participation” and “Personnel and Compensation Committee Report” in our Proxy Statement for the 2022 Annual Meeting of Stockholders, which is expected to be filed with the SEC within 120 days after the close of our fiscal year.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS.

The information required under this item is incorporated herein by reference to “Equity Compensation Plan Information,” “Security Ownership of Directors and Executive Officers” and “Security Ownership of Certain Beneficial Owners” in our Proxy Statement for the 2022 Annual Meeting of Stockholders, which is expected to be filed with the SEC within 120 days after the close of our fiscal year.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE.

The information required under this item is incorporated herein by reference to ‘Certain Relationships and Related Transactions” and “Director Independence” in our Proxy Statement for the 2022 Annual Meeting of Stockholders, which is expected to be filed with the SEC within 120 days after the close of our fiscal year.

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES.

The information required under this item is incorporated herein by reference to “Fees Paid to Auditors” in our Proxy Statement for the 2022 Annual Meeting of Stockholders, which is expected to be filed with the SEC within 120 days after the close of our fiscal year.

PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES.

Financial Statements

Reference is made to the index set forth on page F-1 of this report.

Financial Statement Schedules

The following financial statement schedule of Arch Resources, Inc. is at the page indicated:

All other financial statement schedules listed under SEC rules but not included in this report are omitted because they are not applicable or the required information is provided in the notes to our consolidated financial statements.

Exhibits

Reference is made to the Exhibit Index on the following page.

ITEM 16. FORM 10-K SUMMARY.

None.

Exhibits to be included in 10-K

	Description
2.1	Debtors' Fourth Amended Joint Plan of Reorganization Under Chapter 11 of the Bankruptcy Code (incorporated by reference to Exhibit 2.1 of Arch Resources' Current Report on Form 8-K filed on September 15, 2016).
2.2	Order Confirming Debtors' Fourth Amended Joint Plan of Reorganization Under Chapter 11 of the Bankruptcy Code on September 13, 2016 (incorporated by reference to Exhibit 2.2 of Arch Resources' Current Report on Form 8-K filed on September 15, 2016).
3.1	Restated Certificate of Incorporation of Arch Resources, Inc. (incorporated by reference to Exhibit 3.2 of Arch Resources's Current Report on Form 8-K filed on May 15, 2020.
3.2	Restated Bylaws of Arch Resources, Inc. (incorporated by reference to Exhibit 3.3 of Arch Resources's Current Report on Form 8-K filed on May 15, 2020.
4.1	Form of specimen Class A Common Stock certificate (incorporated by reference to Exhibit 4.1 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
4.2	Form of specimen Class B Common Stock certificate (incorporated by reference to Exhibit 4.2 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
4.3	Form of specimen Series A Warrant certificate (incorporated by reference to Exhibit A of Exhibit 10.5 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
4.4	Description of Registrant's Securities Registered Pursuant to Section 12 of the Securities Exchange Act of 1934, as amended (incorporated by reference to Exhibit 4.4 of Arch Resources's Annual Report on Form 10-K for the year ended 2019).
4.5	Indenture, dated as of November 3, 2020, between Arch Resources, Inc. and UMB Bank, National Association, as trustee (incorporated by reference to Exhibit 4.1 of Arch Resources's Current Report on Form 8-K filed on November 4, 2020).
4.6	Form of certificate representing the 5.25% Convertible Senior Notes due 2025 (incorporated by reference to Exhibit 4.2 of Arch Resources's Current Report on Form 8-K filed on November 4, 2020).
10.1	Credit Agreement, dated as of March 7, 2017, among Arch Resources, Inc. as borrower, the lenders from time to time party thereto and Credit Suisse AG, Cayman Islands Branch, in its capacities as administrative agent and as collateral agent (incorporated by reference to Exhibit 10.1 of Arch Resources's Current Report on Form 8-K filed on March 8, 2017).
10.2	First Amendment to Credit Agreement, dated as of September 25, 2017, among Arch Resources, Inc. as borrower, the lenders from time to time party thereto and Credit Suisse AG, Cayman Islands Branch, in its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.1 of Arch Resources's Current Report on Form 8-K filed on September 25, 2017).
10.3	Second Amendment to Credit Agreement, dated as of April 3, 2018, among Arch Resources, Inc. as borrower, the lenders from time to time party thereto and Credit Suisse AG, Cayman Islands Branch, in its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.1 of Arch Resources's Current Report on Form 8-K filed on April 3, 2018).
10.4	Credit Agreement, dated as of April 27, 2017, among Arch Resources, Inc. and certain of its subsidiaries, as borrowers, the lenders from time to time party thereto and Regions Bank, in its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.1 of Arch Resources's Current Report on Form 8-K filed on May 2, 2017).
10.5	First Amendment to Credit Agreement dated November 19, 2018 by and among Arch Resources, Inc. and certain of its subsidiaries, as borrowers, the lenders from time to time party thereto and Regions Bank, it its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.5 to Arch Resources's Annual Report on Form 10K for the year ended 2018).
10.6	Waiver Letter Agreement and Second Amendment to Credit Agreement dated June 17, 2020 by and among Arch Resources, Inc. and certain of its subsidiaries, as borrowers, the lenders from time to time party thereto and Regions Bank, in its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.6 of Arch Resources's Quarterly Report on Form 10-Q for the period ended September 30, 2020).

10.7	Third Amendment to Credit Agreement dated September 30, 2020, by and among Arch Resources, Inc. and certain of its subsidiaries, as borrowers, the lenders from time to time party thereto Regions Bank, in its capacities as administrative agent and collateral agent (incorporated by reference to Exhibit 10.7 of Arch Resources's Quarterly Report on Form 10-Q for the period ended September 30, 2020).
10.8	Fourth Amendment to Credit Agreement dated May 27, 2021, by and among Arch Resources, Inc. and certain of its subsidiaries, as borrowers, the lenders from time to time party thereto and Regions Bank, in its capacities as administrative agent and as collateral agent (incorporated by reference to Exhibit 10.08 of Arch Resources's Quarterly Report on Form 10-Q for the period ended June 30, 2021).
10.9	Third Amended and Restated Receivables Purchase Agreement, dated October 5, 2016, among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as initial servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.2 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
10.10	First Amendment to Third Amended and Restated Receivables Purchase Agreement, dated as of April 27, 2017, among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.2 of Arch Resources's Current Report on Form 8-K filed on May 2, 2017).
10.11	Second Amendment to Third Amended and Restated Receivables Purchase Agreement, dated as of August 27, 2018, among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.7 of Arch Resources's Quarterly Report on Form 10-Q for the period ended September 30, 2018).
10.12	Third Amendment to Third Amended and Restated Receivables Purchase Agreement, dated as of May 1, 2019, among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.9 of Arch Resources's Quarterly Report on Form 10-Q for the period ended June 30, 2019).
10.13	Fourth Amendment to Third Amended and Restated Receivables Purchase Agreement, dated September 30, 2020, among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.12 of Arch Resources's Quarterly Report on Form 10-Q for the period ended September 30, 2020).
10.14	Fifth Amendment to Third Amended and Restated Receivables Purchase Agreement dated as of December 4, 2020 among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.13 of Arch Resources's Quarterly Report on Form 10-Q for the period ended March 31, 2021).
10.15	Sixth Amendment to Third Amended and Restated Receivables Purchase Agreement dated as of October 8, 2021 among Arch Receivable Company, LLC, as seller, Arch Coal Sales Company, Inc., as servicer, PNC Bank, National Association as administrator and issuer of letters of credit thereunder and the other parties party thereto, as securitization purchasers (incorporated by reference to Exhibit 10.15 of Arch Resources Quaterly Report on Form 10-Q for the period ended September 30, 2021).
10.16	Second Amended and Restated Purchase and Sale Agreement among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.3 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
10.17	First Amendment to the Second Amended and Restated Purchase and Sale Agreement, dated as of December 21, 2016, among Arch Coal, Inc. and certain subsidiaries of Arch Coal, Inc., as originators (incorporated by reference to Exhibit 10.7 of Arch Resources's Quarterly Report on Form 10-Q for the period ended September 30, 2017).

10.18	Second Amendment to the Second Amended and Restated Purchase and Sale Agreement, dated as of April 27, 2017, among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.3 of Arch Resources's Current Report on Form 8-K filed on May 2, 2017).
10.19	Third Amendment to Second Amended and Restated Purchase and Sale Agreement, dated as of September 14, 2017, among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.16 of Arch Resources's Annual Report on Form 10-K for the year ended December 31, 2020).
10.20	Fourth Amendment to Second Amended and Restated Purchase and Sale Agreement, dated as of December 13, 2019, among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.17 of Arch Resources's Annual Report on Form 10-K for the year ended December 31, 2020).
10.21	Fifth Amendment and Waiver to Second Amended and Restated Purchase and Sale Agreement dated June 17, 2020, among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.18 of Arch Resources's Annual Report on Form 10-K for the year ended December 31, 2020).
10.22	Sixth Amendment to Second Amended and Restated Purchase and Sale Agreement dated December 31, 2020, among Arch Resources, Inc. and certain subsidiaries of Arch Resources, Inc., as originators (incorporated by reference to Exhibit 10.19 of Arch Resources's Annual Report on Form 10K for the year ended December 31, 2020).
10.23	Second Amended and Restated Sale and Contribution Agreement between Arch Resources, Inc., as the transferor, and Arch Receivable Company, LLC (incorporated by reference to Exhibit 10.4 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
10.24	First Amendment to the Second Amended and Restated Sale and Contribution Agreement, dated as of April 27, 2017, between Arch Resources, Inc., as the transferor, and Arch Receivable Company, LLC (incorporated by reference to Exhibit 10.4 of Arch Resources's Current Report on Form 8-K filed on May 2, 2017).
10.25	Warrant Agreement, dated as of October 5, 2016, between Arch Resources, Inc. and American Stock Transfer & Trust Company, LLC, as Warrant Agent (incorporated by reference to Exhibit 10.5 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
10.26	Indemnification Agreement between Arch Resources and the directors and officers of Arch Resources and its subsidiaries (form) (incorporated by reference to Exhibit 10.6 of Arch Resources's Current Report on Form 8-K filed on October 11, 2016).
10.27	Registration Rights Agreement between Arch Resources and Monarch Alternative Capital LP and certain other affiliated funds (incorporated by reference to Exhibit 10.1 of Arch Resources's Current Report on Form 8-K filed on November 21, 2016).
10.28	Coal Lease Agreement dated as of March 31, 1992, among Allegheny Land Company, as lessee, and UAC and Phoenix Coal Corporation, as lessors, and related guarantee (incorporated by reference to the Current Report on Form 8-K filed by Ashland Coal, Inc. on April 6, 1992).
10.29	Federal Coal Lease dated as of January 24, 1996 between the U.S. Department of the Interior and the Thunder Basin Coal Company (incorporated by reference to Exhibit 10.20 to Arch Resources's Annual Report on Form 10-K for the year ended December 31, 1998).
10.30	Federal Coal Lease dated as of November 1, 1967 between the U.S. Department of the Interior and the Thunder Basin Coal Company (incorporated herein by reference to Exhibit 10.21 to Arch Resources's Annual Report on Form 10-K for the year ended December 31, 1998).
10.31	Federal Coal Lease effective as of May 1, 1995 between the U.S. Department of the Interior and Mountain Coal Company (incorporated by reference to Exhibit 10.22 to Arch Resources's Annual Report on Form 10-K for the year ended December 31, 1998).
10.32	Federal Coal Lease dated as of January 1, 1999 between the Department of the Interior and Ark Land Company (incorporated by reference to Exhibit 10.23 to Arch Resources's Annual Report on Form 10-K for the year ended December 31, 1998).

10.33	Federal Coal Lease effective as of March 1, 2005 by and between the United States of America and Ark Land LT, Inc. covering the tract of land known as “Little Thunder” in Campbell County, Wyoming (incorporated by reference to Exhibit 99.1 to the Current Report on Form 8-K filed by Arch Resources on February 10, 2005).
10.34	Modified Coal Lease (WYW71692) executed January 1, 2003 by and between the United States of America, through the Bureau of Land Management, as lessor, and Triton Coal Company, LLC, as lessee, covering a tract of land known as “North Rochelle” in Campbell County, Wyoming (incorporated by reference to Exhibit 10.24 to Arch Resources’s Annual Report on Form 10-K for the year ended December 31, 2004).
10.35	Coal Lease (WYW127221) executed January 1, 1998 by and between the United States of America, through the Bureau of Land Management, as lessor, and Triton Coal Company, LLC, as lessee, covering a tract of land known as “North Roundup” in Campbell County, Wyoming (incorporated by reference to Exhibit 10.25 to Arch Resources’s Annual Report on Form 10-K for the year ended December 31, 2004).
10.36*	Letter Agreement dated October 25, 2021 by and between Arch Resources, Inc. and John W. Eaves (incorporated by reference to Exhibit 10.36 of Arch Resources’s Quarterly Report on Form 10-Q for the period ended September 30, 2021).
10.37*	Form of Employment Agreement for Executive Officers of Arch Resources, Inc. (incorporated by reference to Exhibit 10.4 to Arch Resources’s Annual Report on Form 10-K for the year ended December 31, 2011).
10.38*	Arch Resources, Inc. Deferred Compensation Plan (incorporated by reference to Exhibit 10.26 to Arch Resources’s Annual Report on Form 10-K for the year ended December 31, 2014).
10.39*	Arch Resources, Inc. Outside Directors’ Deferred Compensation Plan (incorporated by reference to Exhibit 10.4 of Arch Resources’s Current Report on Form 8-K filed on December 12, 2008).
10.40*	Arch Resources, Inc. Supplemental Retirement Plan (as amended on December 5, 2008) (incorporated by reference to Exhibit 10.2 to Arch Resources’s Current Report on Form 8-K filed on December 12, 2008).
10.41*	Arch Resources, Inc. 2016 Omnibus Incentive Plan (incorporated by reference to Exhibit 99.1 to Arch Resources’s Registration Statement on Form S-8 filed on November 1, 2016).
10.42*	Form of Restricted Stock Unit Contract (Time-Based Vesting) (incorporated by reference to Exhibit 10.1 to Arch Resources’s Current Report on Form 8-K filed on November 30, 2016).
10.43*	Form of Restricted Stock Unit Contract (Performance-Based Vesting) (incorporated by reference to Exhibit 10.2 to Arch Resources’s Current Report on Form 8-k filed on November 30, 2016).
10.44	Stock Repurchase Agreement dated September 13, 2017, among Arch Resources, Inc. and Monarch Alternative Solutions Master Fund Ltd, Monarch Capital Master Partners III LP, MCP Holdings Master LP, Monarch Debt Recovery Master Fund Ltd and P Monarch Recovery Ltd. (incorporated by reference to Exhibit 10.1 of Arch Resources’s Current Report on Form 8-K filed on September 19, 2017).
10.45	Stock Repurchase Agreement dated December 8, 2017, among Arch Resources, Inc. and Monarch Alternative Solutions Master Fund Ltd, Monarch Capital Master Partners III LP, MCP Holdings Master LP and Monarch Debt Recovery Master Fund Ltd. (incorporated by reference to Exhibit 10.1 of Arch Resources’s Current Report on Form 8-K filed on December 11, 2017).
10.46*	Form of Cash Retention Award Agreement for the Chief Executive Officer, Chief Operating Officer and Chief Financial Officer of the Company (incorporated by reference to Exhibit 10.37 to Arch Resources’s annual Report on Form 10-K for the year ended 2018).
10.47	Form of Confirmation of Base Capped Call Transaction (incorporated by reference to Exhibit 10.1 of Arch Resources’s Current Report on Form 8-K filed on November 4, 2020).
21.1	Subsidiaries of the registrant.
23.1	Consent of Ernst & Young LLP.
23.2	Consent of Weir International, Inc.
23.3	Consent of Marshall Miller & Associates, Inc.
24.1	Power of Attorney.
31.1	Rule 13a-14(a)/15d-14(a) Certification of Paul A. Lang.
31.2	Rule 13a-14(a)/15d-14(a) Certification of Matthew C. Giljum.
32.1**	Section 1350 Certification of Paul A. Lang.

32.2**	Section 1350 Certification of Matthew C. Giljum.
95	Mine Safety Disclosure Exhibit.
96.1	Technical Report Summary for Leer Mine – S-K 1300 Report.
96.2	Technical Report Summary for Leer South Mine – S-K 1300 Report.
96.3	Technical Report Summary for Black Thunder Mine – S-K 1300 Report.
101	The following financial statements from the Company's Annual Report on Form 10-K for the year ended December 31, 2021, formatted in Inline XBRL: (1) Consolidated Statements of Operations, (2) Consolidated Statements of Comprehensive Income (Loss), (3) Consolidated Balance Sheets, (4) Consolidated Statements of Cash Flows, (5) Consolidated Statements of Stockholders' Equity and (6) Notes to Consolidated Financial Statements, tagged as blocks of text and including detailed tags.
104	Cover Page Interactive Data File (formatted as Inline XBRL and contained in Exhibit 101).

* Denotes a management contract or compensatory plan or arrangement.
** Furnished herein

Signatures

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

Arch Resources, Inc.

/s/ Paul A. Lang

Paul A. Lang

Chief Executive Officer, Director

February 16, 2022

Signatures	Capacity	Date
/s/ Paul A. Lang Paul A. Lang	Chief Executive Officer, Director (Principal Executive Officer)	February 16, 2022
/s/ Matthew C. Giljum Matthew C. Giljum	Senior Vice President and Chief Financial Officer (Principal Financial Officer)	February 16, 2022
/s/ John W. Lorson John W. Lorson	Vice President and Chief Accounting Officer (Principal Accounting Officer)	February 16, 2022
* John W. Eaves	Executive Chairman	February 16, 2022
* James N. Chapman	Director	February 16, 2022
* Patrick J. Bartels, Jr.	Director	February 16, 2022
* Patrick A. Kriegshauser	Director	February 16, 2022
* Richard A. Navarre	Director	February 16, 2022
* Holly Keller Koeppel	Director	February 16, 2022
* Molly P. Zhang	Director	February 16, 2022

*By /s/ Rosemary L. Klein
Rosemary L. Klein,
Attorney-in-Fact

FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA

Index to Consolidated Financial Statements

Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Arch Resources, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Arch Resources, Inc. and subsidiaries (the Company) as of December 31, 2021 and 2020, the related consolidated statements of operations, comprehensive income (loss), stockholders' equity and cash flows for each of the three years in the period ended December 31, 2021, and the related notes and the financial statement schedule listed in the Index at Item 15 (collectively referred to as the "financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2021 and 2020, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2021, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2021, based on criteria established in Internal Control-Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework), and our report dated February 16, 2022, expressed an unqualified opinion thereon.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matter communicated below is a matter arising from the current period audit of the financial statements that was communicated or required to be communicated to the audit committee and that: (1) relates to accounts or disclosures that are material to the financial statements and (2) involved our especially challenging, subjective or complex judgments. The communication of the critical audit matter does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing a separate opinion on the critical audit matter or on the account or disclosures to which it relates.

Asset Retirement Obligation (ARO) Liability

Description of Critical Audit Matter	At December 31, 2021, the Company's asset retirement obligations totaled $214.5 million. As discussed in Note 2 and Note 16 of the consolidated financial statements, the Company's obligations associated with the retirement of long-lived assets are recognized at fair value at the time the obligations are incurred. Upon initial recognition of a liability, a corresponding amount is capitalized as part of the carrying value of the related long-lived asset. The Company reviews its asset retirement obligations at least annually and makes necessary adjustments for permit changes as granted by state authorities and for revisions of estimates of the timing and extent of reclamation activities and cost estimates. Management's estimate involves a high degree of subjectivity and auditing the significant assumptions utilized by management in estimating the fair value of the liability requires judgement. In particular, the obligation's fair value is determined using a discounted cash flow technique and is based upon mining permit requirements and various assumptions including discount rates, market risk premium, estimates of disturbed acreage, life of the mine, reclamation costs and assumptions regarding equipment productivity.
How we addressed the Matter in our Audit	We obtained an understanding, evaluated the design and tested the operating effectiveness of the controls over the Company's accounting for asset retirement obligations, including controls over management's review of the significant assumptions described above. We assessed the work of the Company's engineering specialists in identifying asset retirement obligation activities against legislative requirements and assessing their timing and likely cost. We compared the Company's methodology to calculate the asset retirement obligations with our industry practice and understanding of the business. We evaluated management's assumptions by validating the underlying inputs within the calculations and recosting studies, including those listed above. We involved a specialist to assist in our evaluation of the accuracy of management's assumptions within the Company's asset retirement obligation estimate including reviewing mine closure regulatory requirements, mine plans and engineering drawings for consistency with permit requirements and conducting virtual observations of mining and reclamation areas.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 1997.

St. Louis, Missouri

February 16, 2022

Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Arch Resources, Inc.

Opinion on Internal Control over Financial Reporting

We have audited Arch Resources, Inc. and subsidiaries internal control over financial reporting as of December 31, 2021, based on criteria established in Internal Control— Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, Arch Resources, Inc. and subsidiaries (the Company) maintained, in all material respects, effective internal control over financial reporting as of December 31, 2021, based on the COSO criteria.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated balance sheets of the Company as of December 31, 2021 and 2020, the related consolidated statements of operations, comprehensive income (loss), stockholders' equity and cash flows for each of the three years in the period ended December 31, 2021, and the related notes and financial statement schedule listed in the Index at Item 15, and our report dated, February 16, 2022 expressed an unqualified opinion thereon.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting included in the accompanying Management's Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects.

Our audit included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ Ernst & Young LLP

St. Louis, Missouri
February 16, 2022

REPORT OF MANAGEMENT

The management of Arch Resources, Inc. (the "Company") is responsible for the preparation of the consolidated financial statements and related financial information in this annual report. The financial statements are prepared in accordance with accounting principles generally accepted in the United States and necessarily include some amounts that are based on management's informed estimates and judgments, with appropriate consideration given to materiality.

The Company maintains a system of internal accounting controls designed to provide reasonable assurance that financial records are reliable for purposes of preparing financial statements and that assets are properly accounted for and safeguarded. The concept of reasonable assurance is based on the recognition that the cost of a system of internal accounting controls should not exceed the value of the benefits derived. The Company has a professional staff of internal auditors who monitor compliance with and assess the effectiveness of the system of internal accounting controls.

The Audit Committee of the Board of Directors, comprised of independent directors, meets regularly with management, the internal auditors, and the independent auditors to discuss matters relating to financial reporting, internal accounting control, and the nature, extent and results of the audit effort. The independent auditors and internal auditors have full and free access to the Audit Committee, with and without management present.

MANAGEMENT'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

The management of Arch Resources, Inc. (the "Company") is responsible for establishing and maintaining adequate internal control over financial reporting, as defined in Securities Exchange Act Rule 13a-15(f). Our internal control over financial reporting is a process designed under the supervision of our principal executive officer and principal financial officer to provide reasonable assurance regarding the reliability of financial reporting and the preparation of consolidated financial statements for external purposes in accordance with accounting principles generally accepted in the United States of America.

Because of its inherent limitations, internal control over financial reporting may not detect or prevent misstatements. Projections of any evaluation of the effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or processes may deteriorate.

Under the supervision and with the participation of the Company's management, including its principal executive officer and principal financial officer, the Company conducted an evaluation of the effectiveness of its internal control over financial reporting as of December 31, 2021 based on the criteria set forth in *Internal Control-Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission. Based on its evaluation, management concluded that the Company's internal control over financial reporting is effective as of December 31, 2021.

The Company's independent registered public accounting firm, Ernst & Young LLP, has issued an audit opinion on the Company's internal control over financial reporting as of December 31, 2021.

Arch Resources, Inc. and Subsidiaries
Consolidated Statements of Operations
(in thousands, except per share data)

	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Revenues	$ 2,208,042	$ 1,467,592	$ 2,294,352
Costs, expenses and other operating			
Cost of sales (exclusive of items shown separately below)	1,579,836	1,378,479	1,873,017
Depreciation, depletion and amortization	120,327	121,552	111,621
Accretion on asset retirement obligations	21,748	19,887	20,548
Change in fair value of coal derivatives and coal trading activities, net	(2,392)	5,219	(18,601)
Selling, general and administrative expenses	92,342	82,397	95,781
Costs related to proposed joint venture with Peabody Energy	—	16,087	13,816
Asset impairment and restructuring	—	221,380	—
Gain on property insurance recovery related to Mountain Laurel longwall	—	(23,518)	—
Loss (Gain) on divestitures	24,225	(1,505)	13,312
Preference Rights Lease Application settlement income	—	—	(39,000)
Other operating expense (income), net	4,826	(22,246)	(19,012)
	1,840,912	1,797,732	2,051,482
Income (loss) from operations	367,130	(330,140)	242,870
Interest expense, net			
Interest expense	(23,972)	(14,432)	(16,485)
Interest and investment income	628	3,808	9,691
	(23,344)	(10,624)	(6,794)
Income (loss) before nonoperating expenses	343,786	(340,764)	236,076
Nonoperating (expenses) income			
Non-service related pension and postretirement benefit costs	(4,339)	(3,884)	(2,053)
Reorganization items, net	—	26	24
	(4,339)	(3,858)	(2,029)
Income (loss) before income taxes	339,447	(344,622)	234,047
Provision for (benefit from) income taxes	1,874	(7)	248
Net income (loss)	$ 337,573	$ (344,615)	$ 233,799
Net income (loss) per common share			
Basic earnings (loss) per share	$ 22.04	$ (22.74)	$ 14.42
Diluted earnings (loss) per share	$ 19.20	$ (22.74)	$ 13.52
Weighted average shares outstanding			
Basic weighted average shares outstanding	15,318	15,153	16,218
Diluted weighted average shares outstanding	17,579	15,153	17,298

The accompanying notes are an integral part of the consolidated financial statements.

Arch Resources, Inc. and Subsidiaries
Consolidated Statements of Comprehensive Income (Loss)
(in thousands)

	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Net income (loss)	$ 337,573	$ (344,615)	$ 233,799
Derivative instruments			
Comprehensive income (loss) before tax	2,128	(1,328)	(5,892)
Income tax benefit (provision)	—	—	—
	2,128	(1,328)	(5,892)
Pension, postretirement and other post-employment benefits			
Comprehensive income (loss) before tax	47,562	(39,732)	(32,038)
Income tax benefit (provision)	—	—	—
	47,562	(39,732)	(32,038)
Available-for-sale securities			
Comprehensive income (loss) before tax	169	(330)	323
Income tax benefit (provision)	—	—	—
	169	(330)	323
Total other comprehensive income (loss)	49,859	(41,390)	(37,607)
Total comprehensive income (loss)	$ 387,432	$ (386,005)	$ 196,192

The accompanying notes are an integral part of the consolidated financial statements.

Arch Resources, Inc. and Subsidiaries
Consolidated Balance Sheets
(in thousands, except per share data)

	December 31, 2021	December 31, 2020
Assets		
Current assets		
Cash and cash equivalents	$ 325,194	$ 187,492
Short-term investments	14,463	96,765
Restricted cash	1,101	5,953
Trade accounts receivable (net of $0 allowance at December 31, 2021 and December 31, 2020)	324,304	110,869
Other receivables	8,271	3,053
Inventories	156,734	126,008
Other current assets	52,804	58,000
Total current assets	882,871	588,140
Property, plant and equipment		
Coal lands and mineral rights	406,822	406,095
Plant and equipment	844,107	734,194
Deferred mine development	402,470	288,693
	1,653,399	1,428,982
Less accumulated depreciation, depletion and amortization	(533,356)	(421,679)
Property, plant and equipment, net	1,120,043	1,007,303
Other assets		
Equity investments	15,403	71,783
Fund for asset retirement obligations	20,000	—
Other noncurrent assets	78,843	55,246
Total other assets	114,246	127,029
Total assets	$ 2,117,160	$ 1,722,472
Liabilities and Stockholders' Equity		
Current Liabilities		
Accounts payable	$ 131,986	$ 103,743
Accrued expenses and other current liabilities	167,304	155,256
Current maturities of debt	223,050	31,097
Total current liabilities	522,340	290,096
Long-term debt	337,623	477,215
Asset retirement obligations	192,672	230,732
Accrued pension benefits	1,300	2,879
Accrued postretirement benefits other than pension	73,565	94,388
Accrued workers' compensation	224,105	244,695
Other noncurrent liabilities	81,689	98,906
Total liabilities	1,433,294	1,438,911
Stockholders' equity		
Common stock, $0.01 par value, authorized 300,000 shares, issued 25,481 and 25,323 shares at December 31, 2021 and December 31, 2020, respectively	255	253
Paid-in capital	784,356	767,484
Retained earnings	712,478	378,906
Treasury stock, 10,088 shares at December 31, 2021 and December 31, 2020, respectively, at cost	(827,381)	(827,381)
Accumulated other comprehensive income (loss)	14,158	(35,701)
Total stockholders' equity	683,866	283,561
Total liabilities and stockholders' equity	$ 2,117,160	$ 1,722,472

The accompanying notes are an integral part of the consolidated financial statements.

Arch Resources, Inc. and Subsidiaries
Consolidated Statements of Cash Flows
(in thousands)

	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Operating activities			
Net income (loss)	$ 337,573	$ (344,615)	$ 233,799
Adjustments to reconcile to cash from operating activities:			
Depreciation, depletion and amortization	120,327	121,552	111,621
Accretion on asset retirement obligations	21,748	19,887	20,548
Deferred income taxes	8	14,430	13,501
Employee stock-based compensation expense	20,539	17,435	21,989
Amortization relating to financing activities	6,549	5,599	3,691
Gain on property insurance recovery related to Mountain Laurel longwall	—	(23,518)	—
Loss (Gain) on disposals and divestitures, net	23,276	(3,727)	8,304
Reclamation work completed	(39,047)	(14,357)	(8,832)
Contribution to fund asset retirement obligations	(20,000)	—	—
Non-cash asset impairment and restructuring	—	198,007	—
Preference Rights Lease Application settlement income	—	—	(39,000)
Changes in:			
Receivables	(212,950)	63,657	30,713
Inventories	(30,726)	(9,126)	(15,251)
Accounts payable, accrued expenses and other current liabilities	45,547	(46,066)	(28,222)
Income taxes, net	1,820	22,859	38,152
Coal derivative assets and liabilities, including margin account	(3,553)	(1,045)	10,117
Asset retirement obligations	(13,697)	(1,787)	(2,623)
Pension, postretirement and other postemployment benefits	4,571	588	(209)
Other	(23,701)	41,333	21,416
Cash provided by operating activities	238,284	61,106	419,714
Investing activities			
Capital expenditures	(245,440)	(285,821)	(266,356)
Minimum royalty payments	(1,186)	(1,248)	(1,249)
Proceeds from disposals and divestitures	21,228	1,007	6,135
Purchases of short-term investments	—	(120,624)	(205,216)
Proceeds from sales of short-term investments	87,486	158,708	233,074
Investments in and advances to affiliates, net	(3,303)	(1,549)	(5,499)
Proceeds from property insurance recovery related to Mountain Laurel longwall	—	23,518	—
Cash used in investing activities	(141,215)	(226,009)	(239,111)
Financing activities			
Payments on term loan	(7,895)	(3,000)	(3,000)
Proceeds from equipment financing	19,438	53,611	—
Proceeds from tax exempt bonds	44,985	53,090	—
Proceeds from convertible debt	—	155,250	—
Purchase of capped call related to convertible debt	—	(17,543)	—
Net payments on other debt	(11,195)	(15,922)	(5,373)
Debt financing costs	(2,057)	(9,718)	—
Dividends paid	(3,830)	(8,245)	(30,220)
Purchases of treasury stock	—	—	(244,998)
Payments for taxes related to net share settlement of equity awards	(4,840)	(2,195)	(8,961)
Proceeds from warrants exercised	1,175	—	—
Other	—	—	32
Cash provided by (used in) financing activities	35,781	205,328	(292,520)
Increase (decrease) in cash and cash equivalents, including restricted cash	132,850	40,425	(111,917)
Cash and cash equivalents, including restricted cash, beginning of period	$ 193,445	$ 153,020	264,937
Cash and cash equivalents, including restricted cash, end of period	$ 326,295	$ 193,445	$ 153,020
Cash and cash equivalents, including restricted cash, end of period			
SUPPLEMENTAL CASH FLOW INFORMATION			
Cash paid during the period for interest	$ 31,568	$ 19,602	$ 16,627
Restricted Cash	1,101	5,953	—
Cash refunded during the period for income taxes, net	$ —	$ 37,535	$ 52,272

The accompanying notes are an integral part of the consolidated financial statements.

Arch Resources, Inc. and Subsidiaries
Consolidated Statements of Stockholders' Equity
Three Years Ended December 31, 2021

	Common Stock	Paid-In Capital	Treasury Stock, at Cost	Retained Earnings Accumulated Income	Accumulated Other Comprehensive Income (Loss)	Total
			(In thousands, except per share data)			
BALANCE AT DECEMBER 31, 2018	$ 250	$ 717,492	$ (583,883)	$ 527,666	$ 43,296	$ 704,821
Dividends on common shares	—	—	—	(30,040)	—	(30,040)
Employee stock-based compensation	—	21,989	—	—	—	21,989
Issuance of 172,720 shares of common stock under long-term incentive plan	2	—	—	—	—	2
Common stock withheld related to net share settlement of equity awards	—	(8,962)	—	—	—	(8,962)
Warrants exercised	—	32	—	—	—	32
Purchase of 2,872,548 shares of common stock under share repurchase program	—	—	(243,498)	—	—	(243,498)
Total comprehensive income	—	—	—	233,799	$ (37,607)	196,192
BALANCE AT DECEMBER 31, 2019	$ 252	$ 730,551	$ (827,381)	$ 731,425	$ 5,689	$ 640,536
Dividends on common shares	—	—	—	(7,904)	—	(7,904)
Employee stock-based compensation	—	17,435	—	—	—	17,435
Issuance of Convertible Debt, net of fees	—	39,237	—	—	—	39,237
Purchase of capped call related to convertible debt	—	(17,543)	—	—	—	(17,543)
Common stock withheld related to net share settlement of equity awards	1	(2,196)	—	—	—	(2,195)
Total comprehensive income (loss)	—	—	—	(344,615)	$ (41,390)	(386,005)
BALANCE AT DECEMBER 31, 2020	$ 253	$ 767,484	$ (827,381)	$ 378,906	$ (35,701)	$ 283,561
Dividends on common shares	—	—	—	(4,001)	—	(4,001)
Issuance of 157,609 shares of common stock under long-term incentive plan	2	—	—	—	—	2
Employee stock-based compensation	—	20,539	—	—	—	20,539
Common stock withheld related to net share settlement of equity awards	—	(4,842)	—	—	—	(4,842)
Warrants exercised	—	1,175	—	—	—	1,175
Total comprehensive income	—	—	—	337,573	$ 49,859	387,432
BALANCE AT DECEMBER 31, 2021	$ 255	$ 784,356	$ (827,381)	$ 712,478	$ 14,158	$ 683,866

Arch Resources, Inc. and Subsidiaries
Notes to Consolidated Financial Statements

1. Basis of Presentation

The accompanying consolidated financial statements include the accounts of Arch Resources, Inc. ("Arch Resources") and its subsidiaries and controlled entities (the "Company"). Unless the context indicates otherwise, the terms "Arch" and the "Company" are used interchangeably in this Annual Report on Form 10-K. The Company's primary business is the production of metallurgical and thermal coal from underground and surface mines located throughout the United States, for sale to steel producers, utility companies, and industrial accounts both in the United States and around the world. The Company currently operates mining complexes in West Virginia, Wyoming and Colorado. All subsidiaries are wholly-owned. Intercompany transactions and accounts have been eliminated in consolidation.

2. Accounting Policies

The accompanying consolidated financial statements have been prepared in accordance with accounting principles generally accepted in the United States for financial reporting and U.S. Securities and Exchange Commission regulations.

Accounting Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and revenues and expenses in the accompanying consolidated financial statements and the disclosure of contingent assets and liabilities. Actual results could differ from those estimates.

Cash and Cash Equivalents

Cash and cash equivalents are stated at cost. Cash equivalents consist of highly-liquid investments with an original maturity of three months or less when purchased and investments in commercial paper which the Company classifies as cash and cash equivalents.

Restricted Cash

Amounts included in restricted cash represent required deposits for a performance bid bond for a potential customer for $1.1 million as of December 31, 2021. Amounts of $6.0 million included in restricted cash held in trust related to the Tax Exempt Bonds as of December 31, 2020.

Accounts Receivable

Accounts receivable are recorded at amounts that are expected to be collected, based on past collection history, the economic environment and specified risks identified in the receivables portfolio.

Inventories

Coal and supplies inventories are valued at the lower of average cost or market. Coal inventory costs include labor, supplies, equipment costs, transportation costs incurred prior to the transfer of title to customers and operating overhead. The costs of removing overburden, called stripping costs, incurred during the production phase of the mine are considered variable production costs and are included in the cost of the coal extracted during the period the stripping costs are incurred.

Investments and Membership Interests in Joint Ventures

Investments and membership interests in joint ventures are accounted for under the equity method of accounting if the Company has the ability to exercise significant influence, but not control, over the entity. The Company's share of the entity's income or loss is reflected in "Other operating loss (income), net" in the Consolidated Statements of Operations. Information about investment activity is provided in Note 11 to the Consolidated Financial Statements, "Equity Method Investments and Membership Interests in Joint Ventures."

Investments in debt securities and marketable equity securities that do not qualify for equity method accounting are classified as available-for-sale and are recorded at their fair values. Unrealized gains and losses on these investments are recorded in other comprehensive income or loss. A decline in the value of an investment that is considered other-than-temporary would be recognized in operating expenses.

Exploration Costs

Costs to acquire permits for exploration activities are capitalized. Drilling and other costs related to locating coal deposits and evaluating the economic viability of such deposits are expensed as incurred.

Prepaid Royalties

Leased mineral rights are often acquired through royalty payments. When royalty payments represent prepayments recoupable against royalties owed on future revenues from the underlying coal, they are recorded as a prepaid asset, with amounts expected to be recouped within one year classified as current. When coal from these leases is sold, the royalties owed are recouped against the prepayment and charged to cost of sales. An impairment charge is recognized for prepaid royalties that are not expected to be recouped.

Property, Plant and Equipment

Plant and Equipment

Plant and equipment were recorded at fair value at emergence during fresh start accounting; subsequent purchases of property, plant and equipment have been recorded at cost. Interest costs incurred during the construction period for major asset additions are capitalized. The Company capitalized $18.6 million and $11.9 million of interest costs during years ended December 31, 2021 and 2020, respectively. Expenditures that extend the useful lives of existing plant and equipment or increase the productivity of the asset are capitalized. The cost of maintenance and repairs that do not extend the useful life or increase the productivity of the asset is expensed as incurred.

Preparation plants and loadouts are depreciated using the units-of-production method over the estimated recoverable reserves, subject to a minimum level of depreciation. Other plant and equipment are depreciated principally using the straight-line method over the estimated useful lives of the assets, limited by the remaining life of the mine. The useful lives of mining equipment, including longwalls, draglines and shovels, range from 1 to 16 years. The useful lives of buildings and leasehold improvements generally range from 3 to 20 years.

Deferred Mine Development

Costs of developing new mines or significantly expanding the capacity of existing mines are capitalized and amortized using the units-of-production method over the estimated recoverable reserves that are associated with the property being benefited. Costs may include construction permits and licenses; mine design; construction of access roads, shafts, slopes and main entries; and removing overburden to access reserves in a new pit. Additionally, deferred mine development includes the asset cost associated with asset retirement obligations. Coal sales revenue related to incidental production during the development phase is recorded as coal sales revenue with an offset to cost of coal sales based on the estimated cost per ton sold for the mine when the asset is in place for its intended use.

Coal Lands and Mineral Rights

Rights to coal reserves may be acquired directly through governmental or private entities. A significant portion of the Company's coal reserves are controlled through leasing arrangements. Lease agreements are generally long-term in nature (original terms range from 10 to 50 years), and substantially all of the leases contain provisions that allow for automatic extension of the lease term providing certain requirements are met. Leases of mineral reserves and related land leases are exempt from the provisions of the leasing standard.

The net book value of the Company's coal interests was $259.8 million and $290.3 million at December 31, 2021 and 2020, respectively. Payments to acquire royalty lease agreements and lease bonus payments are capitalized as a cost of the underlying mineral reserves and depleted over the life of proven and probable reserves. Coal lease rights are depleted using the units-of-production method, and the rights are assumed to have no residual value.

The Company currently does not have any future lease bonus payments.

Depreciation, depletion and amortization

The depreciation, depletion and amortization related to long-lived assets is reflected in the Consolidated Statements of Operations as a separate line item. No depreciation, depletion or amortization is included in any other operating cost categories.

Impairment

If facts and circumstances suggest that the carrying value of a long-lived asset or asset group may not be recoverable, the asset or asset group is reviewed for potential impairment. If this review indicates that the carrying amount of the asset will not be recoverable through projected undiscounted cash flows generated by the asset and its related asset group over its remaining life, then an impairment loss is recognized by reducing the carrying value of the asset to its fair value. The Company may, under certain circumstances, idle mining operations in response to market conditions or other factors. Because an idling is not a permanent closure, it is not considered an automatic indicator of impairment. For information on Impairment, see Note 5 to the Consolidated Financial Statements, "Asset impairment and restructuring."

Deferred Financing Costs

The Company capitalizes costs incurred in connection with new borrowings, the establishment or enhancement of credit facilities and the issuance of debt securities. These costs are amortized as an adjustment to interest expense over the life of the borrowing or term of the credit facility using the effective interest method. Debt issuance costs related to a recognized liability are presented in the balance sheet as a direct reduction from the carrying amount of that liability whereas debt issuance costs related to a credit facility with no balance outstanding are shown as an asset. The unamortized balance of deferred financing costs shown as an asset was $1.2 million at December 31, 2021, with $0.7 million classified as current; the unamortized balance of deferred financing costs shown as an asset at December 31, 2020 was $1.9 million with $0.7 million classified as current. The current amounts are classified within "Other current assets" and the noncurrent amounts are classified within "Other noncurrent assets." For information on the unamortized balance of deferred financing fees related to outstanding debt, see Note 14 to the Consolidated Financial Statements, "Debt and Financing Arrangements."

Revenue Recognition

Revenues include sales to customers of coal produced at Company operations and coal purchased from third parties. The Company recognizes revenue at the time risk of loss passes to the customer at contracted amounts. Transportation costs are included in cost of sales and amounts billed by the Company to its customers for transportation are included in revenues. Control of the goods may transfer and revenue may be recognized before, during or subsequent to the period in which final average pricing is determined. For all metallurgical coal sales under average pricing contracts where pricing is not finalized when revenue is recognized, revenue is recorded based on estimated consideration to be received

at the date of the sale with reference to metallurgical coal price assessments. The Company generally retains title to these products until we receive the first contracted payment, which is typically received shortly after loading, solely to manage the credit risk of the amounts due to the Company. This retention of title does not preclude the customer from obtaining control of the product.

Other Operating Loss (Income), net

Other operating loss (income), net in the accompanying Consolidated Statements of Operations reflects income and expense from sources other than physical coal sales, including: contract settlements; royalties earned from properties leased to third parties; income from equity investments (Note 11, "Equity Method Investments and Membership Interests in Joint Ventures"); non-material gains and losses from divestitures and dispositions of assets; and realized gains and losses on derivatives that do not qualify for hedge accounting and are not held for trading purposes (Note 12, "Derivatives"); and land management expenses.

Asset Retirement Obligations

The Company's legal obligations associated with the retirement of long-lived assets are recognized at fair value at the time the obligations are incurred. Accretion expense is recognized through the expected settlement date of the obligation. Obligations are incurred at the time development of a mine commences for underground and surface mines or construction begins for support facilities, refuse areas and slurry ponds. The obligation's fair value is determined using a discounted cash flow technique and is based upon permit requirements and various estimates and assumptions that would be used by market participants, including estimates of disturbed acreage, reclamation costs and assumptions regarding equipment productivity. Upon initial recognition of a liability, a corresponding amount is capitalized as part of the carrying value of the related long-lived asset.

The Company reviews its asset retirement obligation at least annually and makes necessary adjustments for permit changes as granted by state authorities and for revisions of estimates of the amount and timing of costs. For ongoing operations, adjustments to the liability result in an adjustment to the corresponding asset. For idle operations, adjustments to the liability are recognized as income or expense in the period the adjustment is recorded. Any difference between the recorded obligation and the actual cost of reclamation is recorded in profit or loss in the period the obligation is settled. See additional discussion in Note 16 to the Consolidated Financial Statements, "Asset Retirement Obligations."

Loss Contingencies

The Company accrues for cost related to contingencies when a loss is probable and the amount is reasonably determinable. Disclosure of contingencies is included in the financial statements when it is at least reasonably possible that a material loss or an additional material loss in excess of amounts already accrued may be incurred. The amount accrued represents the Company's best estimate of the loss, or, if no best estimate within a range of outcomes exists, the minimum amount in the range.

Derivative Instruments

The Company generally utilizes derivative instruments to manage exposures to commodity prices and interest rate risk on long-term debt. Derivative financial instruments are recognized on the balance sheet at fair value. Certain coal contracts may meet the definition of a derivative instrument, but because they provide for the physical purchase or sale of coal in quantities expected to be used or sold by the Company over a reasonable period in the normal course of business, they are not recognized on the balance sheet.

Certain derivative instruments are designated as the hedge instrument in a hedging relationship. In a fair value hedge, the Company hedges the risk of changes in the fair value of a firm commitment, typically a fixed-price coal sales contract. Changes in both the hedged firm commitment and the fair value of a derivative used as a hedge instrument in a fair value hedge are recorded in earnings. In a cash flow hedge, the Company hedges the risk of changes in future cash flows related to the underlying item being hedged. Changes in the fair value of the derivative instrument used as a hedge

instrument in a cash flow hedge are recorded in other comprehensive income or loss. Amounts in other comprehensive income or loss are reclassified to earnings when the hedged transaction affects earnings and are classified in a manner consistent with the transaction being hedged. The Company formally documents the relationships between hedging instruments and the respective hedged items, as well as its risk management objectives for hedge transactions.

The Company evaluates the effectiveness of its hedging relationships both at the hedge's inception and on an ongoing basis. Any ineffective portion of the change in fair value of a derivative instrument used as a hedge instrument in a fair value or cash flow hedge is recognized immediately in earnings. The ineffective portion is based on the extent to which exact offset is not achieved between the change in fair value of the hedge instrument and the cumulative change in expected future cash flows on the hedged transaction from inception of the hedge in a cash flow hedge or the change in the fair value. Ineffectiveness was insignificant for the periods disclosed within.

See Note 12 to the Consolidated Financial Statements, "Derivatives" for further disclosures related to the Company's derivative instruments.

Fair Value

Fair value is defined as the price that would be received to sell an asset or paid to transfer a liability in an orderly hypothetical transaction between market participants at a given measurement date. Valuation techniques used must maximize the use of observable inputs and minimize the use of unobservable inputs. See Note 17 to the Consolidated Financial Statements, "Fair Value Measurements" for further disclosures related to the Company's recurring fair value estimates.

Income Taxes

Deferred income taxes are provided for temporary differences arising from differences between the financial statement and tax basis of assets and liabilities existing at each balance sheet date using enacted tax rates anticipated to be in effect when the related taxes are expected to be paid or recovered. A valuation allowance is established if it is more likely than not that a deferred tax asset will not be realized. Management reassesses the ability to realize its deferred tax assets annually in the fourth quarter or when circumstances indicate that the ability to realize deferred tax assets has changed. In determining the need for a valuation allowance, the Company considers projected realization of tax benefits based on expected levels of future taxable income, available tax planning strategies and the reversal of temporary differences.

Benefits from tax positions that are uncertain are not recognized unless the Company concludes that it is more likely than not that the position would be sustained in a dispute with taxing authorities, should the dispute be taken to the court of last resort. The Company would measure any such benefit at the largest amount of benefit that is greater than 50% likely of being realized upon settlement with taxing authorities.

See Note 15 to the Consolidated Financial Statements, "Taxes" for further disclosures about income taxes.

Benefit Plans

The Company has non-contributory defined benefit pension plans covering most of its salaried and hourly employees. On January 1, 2015 the Company's cash balance and excess pension plans were amended to freeze new service credits for any new or active employees. The Company also currently provides certain postretirement medical and life insurance coverage for eligible employees. The cost of providing these benefits is determined on an actuarial basis and accrued over the employees' period of active service.

The Company recognizes the overfunded or underfunded status of these plans as determined on an actuarial basis on the balance sheet and the changes in the funded status are recognized in other comprehensive income. The Company amortizes actuarial gains and losses over the remaining service attribution periods of the employees using the corridor method. See Note 21 to the Consolidated Financial Statements, "Employee Benefit Plans" for additional disclosures relating to these obligations.

Stock-Based Compensation

The compensation cost of all stock-based awards is determined based on the grant-date fair value of the award, and is recognized over the requisite service period. The grant-date fair value of option awards and restricted stock awards with a market condition is determined using a Monte Carlo simulation. Compensation cost for an award with performance conditions is accrued if it is probable that the conditions will be met. The Company accounts for forfeitures as they occur. See further discussion in Note 19 to the Consolidated Financial Statements, “Stock-Based Compensation and Other Incentive Plans.”

Recently Adopted Accounting Guidance

In March 2020, the FASB issued ASU 2020-04, "Reference Rate Reform (Topic 848): Facilitation of the Effects of Reference Rate Reform on Financial Reporting." The amendments provide optional guidance for a limited time to ease the potential burden in accounting for reference rate reform. The new guidance provides optional expedients and exceptions for applying U.S. GAAP to contracts, hedging relationships and other transactions affected by reference rate reform if certain criteria are met. The amendments apply only to contracts and hedging relationships that reference LIBOR or another reference rate expected to be discontinued due to reference rate reform. These amendments are effective immediately and may be applied prospectively to contract modifications made and hedging relationships entered into or evaluated on or before December 31, 2022. We are currently evaluating our contracts and the optional expedients provided by the new standard.

In December 2019, the FASB issued ASU 2019-12, “Income Taxes (Topic 740) Simplifying the Accounting for Income Taxes.” ASU 2019-12 eliminates certain exceptions related to the approach for intraperiod tax allocation, the methodology for calculating income taxes in an interim period and the recognition of deferred tax liabilities for outside basis differences. The ASU is effective for public companies for fiscal years beginning after December 15, 2020, and interim periods therein with early adoption permitted. The Company adopted this ASU with minimal impact to the Company’s financial statements.

Recently Adopted Accounting Guidance Not Yet Effective

In August 2020, the FASB issued ASU 2020-06**,** Debt—Debt with Conversion and Other Options (Subtopic 470-20) and Derivatives and Hedging—Contracts in Entity's Own Equity (Subtopic 815-40)—Accounting for Convertible Instruments and Contracts in an Entity's Own Equity. ASU 2020-06 reduces the number of accounting models for convertible debt instruments and convertible preferred stock. For convertible instruments with conversion features that are not required to be accounted for as derivatives under Topic 815, *Derivatives and Hedging*, or that do not result in substantial premiums accounted for as paid-in capital, the embedded conversion features no longer are separated from the host contract. ASU 2020-06 also removes certain conditions that should be considered in the derivatives scope exception evaluation under Subtopic 815-40, *Derivatives and Hedging—Contracts in Entity's Own Equity*, and clarify the scope and certain requirements under Subtopic 815-40. In addition, ASU 2020-06 improves the guidance related to the disclosures and earnings-per-share (EPS) for convertible instruments and contract in entity’s own equity. ASU 2020-06 is effective for public business entities that meet the definition of a Securities and Exchange Commission (SEC) filer, excluding entities eligible to be smaller reporting companies as defined by the SEC, for fiscal years beginning after December 15, 2021, including interim periods within those fiscal years. For all other entities, the amendments are effective for fiscal years beginning after December 15, 2023, including interim periods within those fiscal years. Upon adoption using the modified retrospective approach in the first quarter of 2022, the Company will no longer have a separate liability and equity component for the Convertible Debt. The total Convertible Debt of $155.3 million will be classified as debt on the Company’s Consolidated Financial Statements. Additionally, this guidance will decrease interest expense and will require the application of the “if-converted” method to calculate the impact of convertible instruments on diluted earnings per share.

3. Accumulated Other Comprehensive Income (Loss)

The following items are included in accumulated other comprehensive income:

	Derivative Instruments	Pension, Postretirement and Other Post-Employment Benefits	Available-for-Sale Securities	Accumulated Other Comprehensive Income (loss)
		(In thousands)		
January 1, 2020	$ (2,564)	$ 8,273	$ (20)	$ 5,689
Unrealized gains (losses)	(3,076)	(38,533)	(66)	(41,675)
Amounts reclassified from accumulated other comprehensive income (loss)	1,749	(1,199)	(265)	285
Balance at December 31, 2020	$ (3,891)	$ (31,459)	$ (351)	$ (35,701)
Unrealized gains (losses)	200	47,159	191	47,550
Amounts reclassified from accumulated other comprehensive income (loss)	1,928	403	(22)	2,309
Balances at December 31, 2021	$ (1,763)	$ 16,103	$ (182)	$ 14,158

The following amounts were reclassified out of accumulated other comprehensive income (loss) during the respective periods:

Details About AOCI Components	December 31, 2021	December 31, 2020	Line Item in the Consolidated Statements of Operations
Coal hedges	$ —	$ 392	Revenues
Interest rate hedges	(1,928)	(2,141)	Interest expense
	—	—	Provision for (benefit from) income taxes
	$ (1,928)	$ (1,749)	Net of tax
Pension, postretirement and other post-employment benefits			
Amortization of actuarial gains (losses), net [1]	$ (2,361)	$ 191	Non-service related pension and postretirement benefit (costs) credits
Amortization of prior service credits	190	112	Non-service related pension and postretirement benefit (costs) credits
Pension settlement	1,768	896	Non-service related pension and postretirement benefit (costs) credits
	—	—	Provision for (benefit from) income taxes
	$ (403)	$ 1,199	Net of tax
Available-for-sale securities [2]	$ 22	$ 265	Interest and investment income
	—	—	Provision for (benefit from) income taxes
	$ 22	$ 265	Net of tax

[1] Production-related benefits and workers' compensation costs are included in costs to produce coal.
[2] The gains and losses on sales of available-for-sale-securities are determined on a specific identification basis.

4. Divestitures

In November 2021, the Company sold its 49.5% ownership in Knight Hawk Holdings, LLC (Knight Hawk") to CBR, LLC. The Company will receive total proceeds of $38 million which consist of $20 million received in the fourth quarter of 2021 and a three year note receivable for $18 million with monthly payments of $0.5 million. The sale resulted in a non-cash loss of $24.2 million that was recorded in "Loss (Gain) on divestitures" as of December 31, 2021. See Note 11 to the Consolidated Financial Statements, "Equity Method Investments and Membership Interests in Joint Venture" for further disclosures about the divestiture.

In December 2020, the Company sold its Viper mine in the Illinois basin to Knight Hawk Holdings, LLC in exchange for an additional 1.5% ownership interest in Knight Hawk. The sale resulted in an increase in the Company's ownership to 49.5% and a gain of $0.1 million was recorded which is reflected within the line item, "Loss (Gain) on divestitures," on the Consolidated Statements of Operations. See Note 11 to the Consolidated Financial Statements, "Equity Method Investments and Membership Interests in Joint Venture" for further disclosures about the divestiture.

During the second quarter of 2020, various Dal-Tex and Briar Branch properties in West Virginia were sold to Condor Holdings, LLC. No consideration was received for the sale and a gain of $1.4 million was recorded representing the net liabilities sold, and is reflected within the line item, “Loss (Gain) on divestitures,” on the Consolidated Statements of Operations.

On December 13, 2019, the Company sold Coal-Mac LLC, an operating mine complex within the Company’s Other Thermal segment to Condor Holdings, LLC. The Company received $2.3 million of proceeds offset by $0.2 million in closing fees; and recorded a loss of $9.0 million which is reflected within the line, “Loss (Gain) on divestitures,” on the Consolidated Statements of Operations.

On September 14, 2017, the Company sold Lone Mountain Processing, LLC and two idled mining companies, Cumberland River Coal LLC and Powell Mountain Energy LLC to Revelation Energy LLC, and recorded a gain on the transaction in that year of $21.3 million. Under the terms of the purchase agreement, Revelation assumed certain traumatic workers compensation claims and pneumoconiosis (occupational disease) benefits. On July 1, 2019, Blackjewel LLC and four affiliates, including Revelation Energy LLC filed for Chapter 11 bankruptcy. As a result of the bankruptcy, the Company recorded a $4.3 million charge for these claims as of September 30, 2019, which is reflected within the line, “Loss (Gain) on divestitures,” on the Consolidated Statements of Operations.

5. Asset impairment and restructuring

During the third quarter of 2020, the Company determined that indicators of impairment existed with respect to certain of its thermal long-lived assets. As a result, the Company recorded impairment charges of $51.8 million related to the Coal Creek Mine, $33.5 million related to the Viper Mine, $41.6 million related to the West Elk Mine, and $36.2 million related to the Company’s equity method investment in Knight Hawk Holdings, LLC.

In the fourth quarter of 2020, the Company recorded additional charges of $32.8 million related to the Company’s Coal Creek Mine due to accelerating the mine closing date and the associated reclamation work to be performed and $10.0 million related to a land lease obligation from a prior equity investment.

The Company recorded $13.4 million of employee severance expense related to a voluntary separation plan during the year ended December 31, 2020. During the first and second quarters of 2020, 254 employees from the Company’s thermal operations and the corporate staff accepted the voluntary separation package. No amounts related to the employee severance expense were incurred for year ended December 31, 2021. As of December 31, 2021, there were no indicators of impairment.

6. Joint Venture with Peabody Energy

The Company incurred expenses of $16.1 million during the year ended December 31, 2020, associated with the regulatory approval process related to the proposed joint venture with Peabody that was terminated jointly by the parties due to the Federal Trade Commission blocking the joint venture during the third quarter of 2020. No amounts related to the joint venture were incurred for the year ended December 31, 2021**.**

7. Gain on Property Insurance Recovery Related to Mountain Laurel Longwall

The Company recorded a $23.5 million gain related to a property insurance recovery on the longwall shields at its Mountain Laurel operation during the year ended December 31, 2020. As a result of geologic conditions in the final longwall panel, Mountain Laurel was unable to recover 123 of the longwall system’s 176 hydraulic shields. No amounts related to the property insurance recovery were incurred for the year ended December 31, 2021.

8. Preference Rights Lease Application Settlement Income

The Company recorded a $39.0 million gain during the third quarter of 2019 related to a settlement with the United States Department of Interior over a long-standing dispute, dating back to the 1970’s, on the valuation and disposition of

Preference Rights Lease Application that Arch controlled in northwestern New Mexico with a joint venture partner. As part of the settlement, Arch received $67.0 million in the form of royalty credits on its federal coal leases which was used to settle 50% of the Company's monthly royalty obligations. Additionally, as part of the settlement, Arch made a one-time payment of $27.0 million during October 2019 to its partner in the venture for its ownership interest in the underlying mineral reserves, as well as paying $1.0 million in closing fees.

The Company utilized royalty credits of $17.7 million during the year ended December 31, 2021, $36.0 million during the year ended December 31, 2020 and $13.3 million during the year ended December 31, 2019.

9. Inventories

Inventories consist of the following:

	December 31, 2021	December 31, 2020
	(In thousands)	
Coal	$ 75,653	$ 49,436
Repair parts and supplies	81,081	76,572
	$ 156,734	$ 126,008

The repair parts and supplies are stated net of an allowance for slow-moving and obsolete inventories of $2.3 million at December 31, 2021 and $0.6 million at December 31, 2020.

10. Investments in Available-for-Sale Securities

The Company has invested in marketable debt securities, primarily highly liquid U.S Treasury securities and investment grade corporate bonds. These investments are held in the custody of a major financial institution. These securities are classified as available-for-sale securities and, accordingly, the unrealized gains and losses are recorded through other comprehensive income.

The Company's investments in available-for-sale marketable securities are as follows:

	December 31, 2021				
	Cost Basis	Gross Unrealized Gains	Gross Unrealized Losses	Allowance for - Credit Losses	Fair Value
			(In thousands)		
Available-for-sale:					
U.S. government and agency securities	$ 6,074	$ —	$ (71)	$ —	$ 6,003
Corporate notes and bonds	8,571	—	(111)	—	8,460
Total Investments	$ 14,645	$ —	$ (182)	$ —	$ 14,463

	December 31, 2020				
	Cost Basis	Gross Unrealized Gains	Gross Unrealized Losses	Allowance for - Credit Losses	Fair Value
			(In thousands)		
Available-for-sale:					
U.S. government and agency securities	$ 57,299	$ 11	$ (86)	$ —	$ 57,224
Corporate notes and bonds	39,817	1	(277)	—	39,541
Total Investments	$ 97,116	$ 12	$ (363)	$ —	$ 96,765

The aggregate fair value of investments with unrealized losses that had been owned for less than a year was $0.0 million and $45.3 million at December 31, 2021 and 2020, respectively. The aggregate fair value of investments with unrealized losses that have been owned for over a year was $14.5 million and $8.1 million at December 31, 2021 and 2020, respectively.

The debt securities outstanding at December 31, 2021 have maturity dates ranging through the first quarter of 2022. The Company classifies its investments as current based on the nature of the investments and their availability to provide cash for use in current operations, if needed.

11. Equity Method Investments and Membership Interests in Joint Ventures

The Company accounts for its investments and membership interests in joint ventures under the equity method of accounting if the Company has the ability to exercise significant influence, but not control, over the entity. Equity method investments are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of the investments may not be recoverable.

Below are the equity method investments reflected in the consolidated balance sheets:

(In thousands)	Knight Hawk	DTA	Total
December 31, 2019	$ 90,211	$ 15,377	$ 105,588
Advances to (distributions from) affiliates, net	(4,235)	1,549	(2,686)
Equity in comprehensive income (loss)	4,576	(1,228)	3,348
Additional interest in Knight Hawk	1,700	—	1,700
Impairment of equity investment	(36,167)	—	(36,167)
December 31, 2020	$ 56,085	$ 15,698	$ 71,783
Advances to (distributions from) affiliates, net	(7,886)	3,303	(4,583)
Equity in comprehensive income (loss)	14,026	(3,598)	10,428
Sale of Equity investment	(62,225)	—	(62,225)
December 31, 2021	$ —	$ 15,403	$ 15,403

In November 2021, the Company sold its 49.5% ownership in Knight Hawk Holdings, LLC (Knight Hawk") to CBR, LLC. The Company received total proceeds of $38 million which consist of $20 million in the fourth quarter of 2021 and a three year note receivable for $18 million with monthly payments of $0.5 million (the first monthly installment was received in the fourth quarter of 2021). The sale resulted in a non-cash loss of $24.2 million that was recorded in "Loss (Gain) on divestitures" as of December 31, 2021.

In December 2020, the Company sold its Viper mine to Knight Hawk Holdings, LLC ("Knight Hawk") in exchange for an additional 1.5% ownership interest in Knight Hawk. The sale resulted in an increase in the Company's ownership to 49.5%.

The Company holds a 35% general partnership interest in Dominion Terminal Associates LLP ("DTA"), which is accounted for under the equity method. DTA operates a ground storage-to-vessel coal transloading facility in Newport News, Virginia for use by the partners. Under the terms of a throughput and handling agreement with DTA, each partner is charged its share of cash operating and debt-service costs in exchange for the right to use the facility's loading capacity and is required to make periodic cash advances to DTA to fund such costs.

The Company is not required to make any future contingent payments related to development financing for any of its equity investees.

12. Derivatives

Interest rate risk management

The Company has entered into interest rate swaps to reduce the variability of cash outflows associated with interest payments on its variable rate term loan. These swaps have been designated as cash flow hedges. For additional information on these arrangements, see Note 14 to the Consolidated Financial Statements, “Debt and Financing Arrangements.”

Diesel fuel price risk management

The Company is exposed to price risk with respect to diesel fuel purchased for use in its operations. The Company anticipates purchasing approximately 40 to 45 million gallons of diesel fuel for use in its operations during 2022. To protect the Company’s cash flows from increases in the price of diesel fuel for its operations, the Company purchased heating oil call options. At December 31, 2021, the Company had protected the price of expected diesel fuel purchases for 2022 with approximately 8 million gallons of heating oil call options with an average strike price of $2.38 per gallon. These positions are not designated as hedges for accounting purposes, and therefore, changes in the fair value are recorded immediately to earnings.

Coal risk management positions

The Company may sell or purchase forward contracts, swaps and options in the over-the-counter coal market in order to manage its exposure to coal prices. The Company has exposure to the risk of fluctuating coal prices related to forecasted sales or purchases of coal or to the risk of changes in the fair value of a fixed price physical sales contract. Certain derivative contracts may be designated as hedges of these risks.

At December 31, 2021, the Company held derivatives for risk management purposes that are expected to settle in the following years:

(Tons in thousands)	2022
Coal sales	165
Coal purchases	33

Tabular derivatives disclosures

The Company has master netting agreements with all of its counterparties which allow for the settlement of contracts in an asset position with contracts in a liability position in the event of default or termination. Such netting arrangements reduce the Company’s credit exposure related to these counterparties. For classification purposes, the Company records the net fair value of all the positions with a given counterparty as a net asset or liability in the consolidated balance sheets. The amounts shown in the table below represent the fair value position of individual contracts, and not the net position presented in the accompanying Consolidated Balance Sheets.

The fair value and location of derivatives reflected in the accompanying Consolidated Balance Sheets are as follows:

Fair Value of Derivatives (In thousands)	December 31, 2021 Asset Derivative	December 31, 2021 Liability Derivative		December 31, 2020 Asset Derivative	December 31, 2020 Liability Derivative	
Derivatives Designated as Hedging Instruments						
Coal	$ —	$ —		$ —	$ —	
Derivatives Not Designated as Hedging Instruments						
Heating oil -- diesel purchases	1,219	—		237	—	
Coal -- held for trading purposes	—	—		1,914	(1,595)	
Coal -- risk management	4,885	(2,203)		1,094	(804)	
Total	$ 6,104	$ (2,203)		$ 3,245	$ (2,399)	
Total derivatives	$ 6,104	$ (2,203)		$ 3,245	$ (2,399)	
Effect of counterparty netting	(1,890)	1,890		(2,392)	2,392	
Net derivatives as classified in the balance sheets	$ 4,214	$ (313)	$ 3,901	$ 853	$ (7)	$ 846

Net derivatives as reflected on the balance sheets (in thousands)		December 31, 2021	December 31, 2020
Heating Oil and coal	Other current assets	$ 4,214	$ 853
Coal	Accrued expenses and other current liabilities	(313)	(7)
		$ 3,901	$ 846

The Company had a current asset representing cash collateral posted to a margin account for derivative positions primarily related to coal derivatives of $2.8 million at December 31, 2021 and a current asset of $1.4 million at December 31, 2020 representing cash collateral owed to a margin account, respectively. These amounts are not included with the derivatives presented in the table above and are included in “accrued expenses and other current liabilities” and “other current assets” in the accompanying Consolidated Balance Sheets.

The effects of derivatives on measures of financial performance are as follows:

Derivatives used in Cash Flow Hedging Relationships (in thousands)

For the noted periods,

		Gain (Loss) Recognized in Other Comprehensive Income (Effective Portion)		
		Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Coal sales	(1)	$ —	$ 500	$ 10,249
Coal purchases	(2)	—	(496)	(1,231)
		$ —	$ 4	$ 9,018

	Gains (Losses) Reclassified from Other Comprehensive Income into Income (Effective Portion)		
	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Coal sales	$ —	$ (1,850)	$ 10,167
Coal purchases	—	1,458	(686)
	$ —	$ (392)	$ 9,481

No ineffectiveness or amounts excluded from effectiveness testing relating to the Company's cash flow hedging relationships were recognized in the results of operations in the respective periods.

Derivatives Not Designated as Hedging Instruments (in thousands)

For the noted periods,

		Gain (Loss) Recognized		
		Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Coal trading— realized and unrealized	(3)	$ —	$ 222	$ (1,013)
Coal risk management— unrealized	(3)	2,392	(5,517)	19,713
Natural gas trading — realized and unrealized	(3)	—	76	(99)
Change in fair value of coal derivatives and coal trading activities, net total		$ 2,392	$ (5,219)	$ 18,601
Coal risk management — realized	(4)	$ (27,464)	$ 9,258	$ 487
Heating oil — diesel purchases	(4)	$ —	$ (558)	$ (2,291)

Location in income statement:

- **(1)** — Revenues
- **(2)** — Cost of sales
- **(3)** — Change in fair value of coal derivatives and coal trading activities, net
- **(4)** — Other operating income, net

13. Accrued Expenses and Other Current Liabilities

Accrued expenses and other current liabilities consist of the following:

	December 31, 2021	December 31, 2020
	(In thousands)	
Payroll and employee benefits	$ 55,898	$ 39,443
Taxes other than income taxes	61,582	56,232
Interest	3,439	2,795
Workers' compensation	14,202	15,259
Asset retirement obligations	21,781	27,032
Other	10,402	14,495
	$ 167,304	$ 155,256

14. Debt and Financing Arrangements

	December 31, 2021	December 31, 2020
	(In thousands)	
Term loan due 2024 ($280.9 million face value)	$ 280,353	$ 288,033
Tax Exempt Bonds ($98.1 million face value)	98,075	53,090
Convertible Debt ($155.3 million face value)	121,617	115,367
Other	70,836	62,695
Debt issuance costs	(10,208)	(10,873)
	560,673	508,312
Less: current maturities of debt	223,050	31,097
Long-term debt	$ 337,623	$ 477,215

Term Loan Facility

In 2017, the Company entered into a senior secured term loan credit agreement in an aggregate principal amount of $300 million (the “Term Loan Debt Facility”) with Credit Suisse AG, Cayman Islands Branch, as administrative agent and collateral agent, and the other financial institutions from time to time party thereto (collectively, the “Lenders”). The Term Loan Debt Facility was issued at 99.50% of the face amount and will mature on March 7, 2024. The term loans provided under the Term Loan Debt Facility (the “Term Loans”) are subject to quarterly principal amortization payments in an amount equal to $0.8 million. The interest rate on the Term Loan Debt Facility is, at the option of Arch Resources, either (i) LIBOR plus an applicable margin of 2.75%, subject to a 1.00% LIBOR floor, or (ii) a base rate plus an applicable margin of 1.75%.

The Term Loan Debt Facility is guaranteed by all existing and future wholly owned domestic subsidiaries of the Company (collectively, the “Subsidiary Guarantors” and, together with Arch Resources, the “Loan Parties”), subject to customary exceptions, and is secured by first priority security interests on substantially all assets of the Loan Parties, including 100% of the voting equity interests of directly owned domestic subsidiaries and 65% of the voting equity interests of directly owned foreign subsidiaries, subject to customary exceptions.

The Company has the right to prepay Term Loans at any time and from time to time in whole or in part without premium or penalty, upon written notice, except that any prepayment of Term Loans that bear interest at the LIBOR Rate other than at the end of the applicable interest periods therefor shall be made with reimbursement for any funding losses and redeployment costs of the Lenders resulting therefrom.

The Term Loan Debt Facility is subject to certain usual and customary mandatory prepayment events, including 100% of net cash proceeds of (i) debt issuances (other than debt permitted to be incurred under the terms of the New Term Loan Debt Facility) and (ii) non-ordinary course asset sales or dispositions, subject to customary thresholds, exceptions and reinvestment rights.

The Term Loan Debt Facility contains customary affirmative covenants and representations.

The Term Loan Debt Facility also contains customary negative covenants, which, among other things, and subject to certain exceptions, include restrictions on (i) indebtedness, (ii) liens, (iii) liquidations, mergers, consolidations and acquisitions, (iv) disposition of assets or subsidiaries, (v) affiliate transactions, (vi) creation or ownership of certain subsidiaries, partnerships and joint ventures, (vii) continuation of or change in business, (viii) restricted payments, (ix) prepayment of subordinated and junior lien indebtedness, (x) restrictions in agreements on dividends, intercompany loans and granting liens on the collateral, (xi) loans and investments, (xii) sale and leaseback transactions, (xiii) changes in organizational documents and fiscal year and (xiv) transactions with respect to bonding subsidiaries. The Term Loan Debt Facility does not contain any financial maintenance covenant.

The Term Loan Debt Facility contains customary events of default, subject to customary thresholds and exceptions, including, among other things, (i) nonpayment of principal and nonpayment of interest and fees, (ii) a material inaccuracy of a representation or warranty at the time made, (iii) a failure to comply with any covenant, subject to customary grace periods in the case of certain affirmative covenants, (iv) cross-events of default to indebtedness of at

least $50 million, (v) cross-events of default to surety, reclamation or similar bonds securing obligations with an aggregate face amount of at least $50 million, (vi) uninsured judgments in excess of $50 million, (vii) any loan document shall cease to be a legal, valid and binding agreement, (viii) uninsured losses or proceedings against assets with a value in excess of $50 million, (ix) certain ERISA events, (x) a change of control or (xi) bankruptcy or insolvency proceedings relating to the Company or any material subsidiary of the Company.

At December 31, 2021, the Company agreed to repurchase $69.7 million of the Term Loans before year end that settled in 2022. This amount is included in current maturities of debt on the Company's Consolidated Balance Sheet.

Accounts Receivable Securitization Facility

On September 30, 2020, the Company amended and extended its existing trade accounts receivable securitization facility provided to Arch Receivable Company, LLC, a special-purpose entity that is a wholly owned subsidiary of Arch Resources ("Arch Receivable") (the "Securitization Facility"), which supports the issuance of letters of credit and requests for cash advances. The amendment to the Securitization Facility reduced the size of the facility from $160 million to $110 million of borrowing capacity and extended the maturity date to September 29, 2023.

Under the Securitization Facility, Arch Receivable, Arch Resources and certain of Arch Resources's subsidiaries party to the Securitization Facility have granted to the administrator of the Securitization Facility a first priority security interest in eligible trade accounts receivable generated by such parties from the sale of coal and all proceeds thereof. As of December 31, 2021, letters of credit totaling $67.5 million were outstanding under the facility with $42.5 million available for borrowings.

Inventory-Based Revolving Credit Facility

On September 30, 2020, Arch Resources amended the senior secured inventory-based revolving credit facility in an aggregate principal amount of $50 million (the "Inventory Facility") with Regions Bank ("Regions") as administrative agent and collateral agent, as lender and swingline lender (in such capacities, the "Lender") and as letter of credit issuer. Availability under the Inventory Facility is subject to a borrowing base consisting of (i) 85% of the net orderly liquidation value of eligible coal inventory, plus (ii) the lesser of (x) 85% of the net orderly liquidation value of eligible parts and supplies inventory and (y) 35% of the amount determined pursuant to clause (i), plus (iii) 100% of Arch Resources's Eligible Cash (defined in the Inventory Facility), subject to reduction for reserves imposed by Regions.

The amendment of the Inventory Facility extended the maturity of the facility to September 30, 2023; eliminated the provision that accelerated maturity upon Liquidity (as defined in the Inventory Facility) falling below a specified level; and reduced the minimum Liquidity requirement from $175 million to $100 million. Additionally, the amendment included provisions that reduce the advance rates for coal inventory and parts and supplies, depending on "Liquidity" as defined as of any date of determination, the sum of, without duplication, (a) unrestricted cash or Permitted Investments as of such date of the Parent and its Subsidiaries (other than the Securitization Subsidiaries and Bonding Subsidiaries) that are not Foreign Subsidiaries, (b) withdrawable funds from brokerage accounts of Borrowers as of such date, (c) Availability as of such date, and (d) any unused commitments that are available to be drawn as of such date by the Parent pursuant to the terms of any Permitted Receivables Financing.

Revolving loan borrowings under the Inventory Facility bear interest at a per annum rate equal to, at the option of Arch Resources, either the base rate or the London interbank offered rate plus, in each case, a margin ranging from 2.50% to 3.50% (in the case of LIBOR loans) subject to a 0.75% LIBOR floor, and 1.50% to 2.50% (in the case of base rate loans) determined using a Liquidity-based grid. Letters of credit under the Inventory Facility are subject to a fee in an amount equal to the applicable margin for LIBOR loans, plus customary fronting and issuance fees.

All existing and future direct and indirect domestic subsidiaries of Arch Resources, subject to customary exceptions, will either constitute co-borrowers under or guarantors of the Inventory Facility (collectively with Arch Resources, the "Loan Parties"). The Inventory Facility is secured by first priority security interests in the ABL Priority Collateral (defined in the Inventory Facility) of the Loan Parties and second priority security interests in substantially all other

assets of the Loan Parties, subject to customary exceptions (including an exception for the collateral that secures the Securitization Facility).

Arch Resources has the right to prepay borrowings under the Inventory Facility at any time and from time to time in whole or in part without premium or penalty, upon written notice, except that any prepayment of such borrowings that bear interest at the LIBOR rate other than at the end of the applicable interest periods therefore shall be made with reimbursement for any funding losses and redeployment costs of the Lender resulting therefrom.

The Inventory Facility is subject to certain usual and customary mandatory prepayment events, including non-ordinary course asset sales or dispositions, subject to customary thresholds, exceptions (including exceptions for required prepayments under Arch Resources's term loan facility) and reinvestment rights.

The Inventory Facility contains certain customary affirmative and negative covenants; events of default, subject to customary thresholds and exceptions; and representations, including certain cash management and reporting requirements that are customary for asset-based credit facilities. The Inventory Facility also includes a requirement to maintain Liquidity equal to or exceeding $100 million at all times. As of December 31, 2021, letters of credit totaling $27.7 million were outstanding under the facility with $6.4 million available for borrowings.

Equipment Financing

On March 4, 2020, the Company entered into an equipment financing arrangement accounted for as debt. The Company received $53.6 million in exchange for conveying an interest in certain equipment in operation at its Leer Mine and entered into a master lease arrangement for that equipment. The financing arrangement contains customary terms and events of default and provides for 48 monthly payments with an average interest rate of 6.34% maturing on March 4, 2024. Upon maturity, all interests in the subject equipment will revert back to the Company.

On July 29, 2021, the Company entered into an additional equipment financing arrangement accounted for as debt. The Company received $23.5 million in exchange for conveying an interest in certain equipment in operation at its Powder River Basin operations and entered into a master lease arrangement for that equipment. The financing arrangement contains customary terms and events of default and provides for 42 monthly payments with an average implied interest rate of 7.35% maturing on February 1, 2025. Upon maturity, the Company will have the option to purchase the equipment.

Tax Exempt Bonds

On July 2, 2020, the West Virginia Economic Development Authority (the "Issuer") issued $53.1 million aggregate principal amount of Solid Waste Disposal Facility Revenue Bonds (Arch Resources Project), Series 2020 (the "2020 Tax Exempt Bonds") pursuant to an Indenture of Trust dated as of June 1, 2020 (as amended to date, the "Indenture of Trust") between the Issuer and Citibank, N.A., as trustee (the "Trustee"). On March 4, 2021, the Issuer issued an additional $45.0 million of Series 2021 Tax Exempt Bonds (the "2021 Tax Exempt Bonds" and together with the 2020 Tax Exempt Bonds, the "Tax Exempt Bonds"). The proceeds of the Tax Exempt Bonds were loaned to the Company pursuant to a Loan Agreement dated as of June 1, as supplemented by a First Amendment to Loan Agreement dated as of March 1, 2021 (collectively, the "Loan Agreement"), each between the Issuer and the Company. The Tax Exempt Bonds are payable solely from payments to be made by the Company under the Loan Agreement as evidenced by a Note from the Company to the Trustee. The proceeds of the Tax Exempt Bonds were used to finance certain costs of the acquisition, construction, reconstruction, and equipping of solid waste disposal facilities at the Company's Leer South development, and for capitalized interest and certain costs related to issuance of the Tax Exempt Bonds.

The Tax Exempt Bonds will bear interest payable each January 1 and July 1, and have a final maturity of July 1, 2045; however, the Tax Exempt Bonds are subject to mandatory tender on July 1, 2025 at a purchase price equal to 100% of the principal amount of the Tax Exempt Bonds, plus accrued interest to July 1, 2025. The 2020 Tax Exempt Bonds and 2021 Tax Exempt Bonds bear interest of 5% and 4.125%, respectively.

The Tax Exempt Bonds are subject to redemption (i) in whole or in part at any time on or after January 1, 2025 at the option of the Issuer, upon the Company's direction at a redemption price of par, plus interest accrued to the redemption date; and (ii) at par plus interest accrued to the redemption date from certain excess Tax Exempt Bonds proceeds as further described in the Indenture of Trust.

The Company's obligations under the Loan Agreement are (i) except as otherwise described below, secured by first priority liens on and security interests in substantially all of the Company's and Subsidiary Guarantors' real property and other assets, subject to certain customary exceptions and permitted liens, and in any event excluding accounts receivable and inventory; and (ii) jointly and severally guaranteed by the Subsidiary Guarantors, subject to customary exceptions.

The collateral securing the Company's obligations under the Loan Agreement is substantially the same as the collateral securing the obligations under the Term Loan Debt Facility other than with respect to variances in certain real property collateral. The real property securing the Company's obligations under the Loan Agreement includes a subset of the real property collateral securing the obligations under the Term Loan Debt Facility and includes only mortgages on substantially all of the Company's revenue generating real property and assets.

The Loan Agreement contains certain affirmative covenants and representations, including but not limited to: (i) maintenance of a rating on the Tax Exempt Bonds; (ii) maintenance of proper books of records and accounts; (iii) agreement to add additional guarantors to guarantee the obligations under the Loan Agreement in certain circumstances; (iv) procurement of customary insurance; and (v) preservation of legal existence and certain rights, franchises, licenses and permits. The Loan Agreement also contains certain customary negative covenants, which, among other things, and subject to certain exceptions, include restrictions on (i) release of collateral securing the Company's obligations under the Loan Agreement; (ii) mergers and consolidations and disposition of assets, and (iii) restrictions on actions that may jeopardize the tax-exempt status of the Tax Exempt Bonds.

The Loan Agreement contains customary events of default, subject to customary thresholds and exceptions, including, among other things: (i) nonpayment of principal, purchase price, interest and other fees (subject to certain cure periods); (ii) bankruptcy or insolvency proceedings relating to us; (iii) material inaccuracy of a representation or warranty at the time made; (iv) cross-events of default to indebtedness of at least $50 million; and (v) cross defaults to the Indenture of Trust, the guaranty related to the Tax Exempt Bonds or any related security documents.

As of December 31, 2021, the Company has utilized the total Tax Exempt Bond proceeds.

Convertible Debt

On November 3, 2020, the Company issued $155.3 million in aggregate principal amount of 5.25% convertible senior notes due 2025 ("Convertible Notes " or "Convertible Debt"). The net proceeds from the issuance of the Convertible Notes, after deducting offering related costs of $5.1 million and cost of a "Capped Call Transaction" as defined below of $17.5 million, were approximately $132.7 million. The Convertible Notes bear interest at the annual rate of 5.25%, payable semiannually in arrears on May 15 and November 15 of each year, beginning on May 15, 2021, and will mature on November 15, 2025, unless earlier converted or repurchased by the Company.

The Convertible Notes will be convertible into cash, shares of the Company's common stock or a combination thereof, at the Company's election, at an initial conversion rate of 26.7917 shares of common stock per $1,000 principal amount of Convertible Notes, which is equivalent to an initial conversion price of approximately $37.325 per share, subject to adjustment pursuant to the terms of the Indenture governing the Convertible Notes (the "Indenture"). During the fourth quarter of 2021, the strike price was revalued to $37.208 per share to include the fourth quarter dividend declaration. The Convertible Notes may be converted at any time after, and including, July 15, 2025 until the close of business on the second scheduled trading day immediately before the maturity date.

The conversion rate of the Convertible Notes may be adjusted in certain circumstances, including in connection with a conversion of the Convertible Notes made following certain fundamental changes and under other circumstances set forth in the Indenture. It is the Company's current intent and policy to settle any conversions of notes through a combination of cash and shares.

The Convertible Notes will be redeemable, in whole and not part, at the Company's option at any time on or after November 20, 2023 and on or before the 40th scheduled trading day immediately before the maturity date, at a cash redemption price equal to the principal amount of the Convertible Notes to be redeemed, plus accrued and unpaid interest, if any, to, but excluding, the redemption date, but only if the last reported sale price per share of the Company's common stock exceeds 130% of the conversion price on: (i) each of at least 20 trading days, whether or not consecutive, during the 30 consecutive trading days ending on, and including, the trading day immediately before the date the Company sends the related redemption notice; and (ii) the trading day immediately before the date the Company sends such notice. In addition, calling the Convertible Notes for redemption will constitute a Make-Whole Fundamental Change, which will result in an increase to the conversion rate in certain circumstances for a specified period of time. No sinking fund is provided for the Convertible Notes.

During the fourth quarter of 2021, the common stock sale condition of the Convertible Notes was satisfied. As described in the Indenture, this condition is satisfied when the closing stock price exceeds 130% of the conversion price of approximately $37.208 per share for at least 20 trading days of the last 30 trading days prior to quarter end. As a result, the Convertible Notes are currently convertible at the election of noteholders during the first quarter of 2022. Due to the Company's stated intent to settle the principal value in cash, the liability portion of $121.6 million of the Convertible Notes was included in current maturities of debt on the Company's Consolidated Balance Sheet at December 31, 2021.

As of December 31, 2021, all of the Convertible Notes remained outstanding. In addition, from January 1, 2022 to the date of this filing, the Company has not received any conversion requests for Convertible Notes and does not anticipate receiving any conversion requests in the near term as the market value of the Convertible Notes exceeds the conversion value of the Convertible Notes. As of December 31, 2021, the if-converted value of the Convertible Notes exceeded the principal amount by $225.3 million.

Total interest expense related to the Convertible Debt for the year ended December 31, 2021 was $15.1 million and was comprised of $8.2 million related to the contractual interest coupon and $6.9 million related to the amortization of the discount on the liability component.

Capped Call Transactions

In connection with the offering of the Convertible Notes, the Company entered into privately negotiated convertible note hedge transactions (collectively, the "Capped Call Transactions"). The Capped Call Transactions cover, subject to customary anti-dilution adjustments, the number of shares of the Company's common stock that initially underlie the Convertible Notes.

The Capped Call Transactions are expected generally to reduce the potential dilution and/or offset any cash payments the Company is required to make in excess of the principal amount due upon conversion of the Convertible Notes in the event that the market price of the Company's common stock is greater than the strike price of the Capped Call Transactions, which was initially $37.325 per share (subject to adjustment under the terms of the Capped Call Transactions). During the fourth quarter of 2021, the conversion rate was adjusted to 26.876 shares of common stock per $1,000 principal amount of Convertible Notes to account for the fourth quarter dividend declaration. The number of shares underlying the Capped Call Transactions is 4.2 million.

The cap price of the Capped Call Transactions was initially $52.2550 per share, which represented a premium of 75% over the last reported sale price of the Company's common stock on October 29, 2020. The cost of the Capped Call Transactions was approximately $17.5 million.

The Capped Call Transactions are separate transactions, in each case entered into between the Company and the respective Option Counterparty, and are not part of the terms of the Convertible Notes and will not affect any holder's rights under the Convertible Notes. Holders of the Convertible Notes will not have any rights with respect to the Capped Call Transactions. Additionally, the cost of the Capped Call Transactions is not expected to be tax deductible as the Company did not elect to integrate the Capped Call Transactions into the notes for tax purposes.

Accounting Treatment of the Convertible Notes and Related Hedge Transactions

As the Capped Call Transactions meet certain accounting criteria, the Capped Call Transactions were classified as equity and are not accounted for as derivatives. The proceeds from the offering of the Convertible Notes were separated into liability and equity components. On the date of issuance, the liability and equity components of the Convertible Notes were calculated to be approximately $114.5 million and $40.8 million, respectively. The initial $114.5 million liability component was determined based on the fair value of similar debt instruments excluding the conversion feature assuming a hypothetical interest rate of 12.43%. The inputs and assumptions used in the calculated fair value of the liability component of the convertible debt fall within level 2 of the fair value hierarchy. The initial $40.8 million equity component represents the difference between the fair value of the initial $114.5 million in debt and the $155.3 million of gross proceeds. The equity component is included in additional paid-in capital in the Consolidated Balance Sheets and will not be subsequently remeasured as long as it continues to meet the conditions for equity classification. The related initial debt discount of $40.8 million is being amortized over the life of the Convertible Notes as non-cash interest expense using the effective interest method.

In connection with the above-noted transactions, the Company incurred approximately $5.9 million of debt issuance costs. These offering expenses were allocated to the liability and equity components in proportion to the allocation of proceeds and accounted for as debt and equity issuance costs, respectively. The Company allocated $4.4 million of debt issuance costs to the liability component, which were capitalized as deferred financing costs within long-term debt. These costs are being amortized as interest expense over the term of the debt (which coincides with the five year life of the Convertible notes) using the effective interest method. The remaining $1.5 million of transaction costs allocated to the equity component were recorded as a reduction of the equity component.

Interest Rate Swaps

The Company has entered into a series of interest rate swaps to fix a portion of the LIBOR interest payments due under the term loan. The interest rate swaps qualify for cash flow hedge accounting treatment and as such, the change in the fair value of the interest rate swaps are recorded on the Company's Consolidated Balance Sheets as an asset or liability with the effective portion of the gains or losses reported as a component of accumulated other comprehensive income and the ineffective portion reported in earnings. As interest payments are made on the term loan, amounts in accumulated other comprehensive income will be reclassified into earnings through interest expense to reflect a net interest on the term loan equal to the effective yield of the fixed rate of the swap plus 2.75% which is the spread on the revised LIBOR term loan. In the event that an interest rate swap is terminated prior to maturity, gains or losses in accumulated other comprehensive income will remain deferred and reclassified into earnings in the periods which the hedged forecasted transaction affects earnings.

Below is a summary of the Company's outstanding interest rate swap agreements designated as hedges as of December 31, 2021:

Notional Amount (in millions)	Effective Date	Fixed Rate	Receive Rate	Expiration Date
$ 100.0	June 30, 2021	2.315 %	1-month LIBOR	June 30, 2023

The fair value of the interest rate swaps at December 31, 2021 is a liability of $1.8 million which is recorded within Other noncurrent liabilities with the offset to accumulated other comprehensive income on the Company's Consolidated Balance Sheets. The Company realized $1.9 million of losses and $2.1 million and $1.1 million of gains during the years ended December 31, 2021, 2020 and 2019, respectively, related to settlements of the interest rate swaps which were recorded to interest expense on the Company's Consolidated Statements of Operations. The interest rate swaps are classified as level 2 within the fair value hierarchy.

Debt Maturities

The contractual maturities of debt as of December 31, 2021 are as follows:

Year	(In thousands)
2022	$ 107,733
2023	22,304
2024	213,934
2025	261,090
2026	—
Thereafter	—
	$ 605,061

Financing Costs

The Company paid financing costs of $2.1 million, $9.7 million and $0.0 million during the years ended December 31, 2021, 2020 and 2019, respectively.

15. Taxes

Significant components of the provision for (benefit from) income taxes are as follows:

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Current:			
Federal	$ 1,525	$ 518	$ (36)
State	342	(569)	124
Total current	$ 1,867	$ (51)	$ 88
Deferred:			
Federal	$ 7	$ 44	$ 667
State	—	—	(507)
Total deferred	$ 7	$ 44	$ 160
	$ 1,874	$ (7)	$ 248

A reconciliation of the statutory federal income tax provision (benefit) at the statutory rate to the actual provision for (benefit from) income taxes follows:

	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Income tax provision (benefit) at statutory rate	$ 71,284	$ (72,371)	$ 49,150
Percentage depletion and other perm items	(29,392)	(7,763)	(17,743)
State taxes, net of effect of federal taxes	16,490	(3,298)	(12,769)
Change in valuation allowance	(69,603)	76,524	(24,206)
Other, net	13,095	6,901	5,816
Provision for (benefit from) income taxes	$ 1,874	$ (7)	$ 248

Significant components of the Company's deferred tax assets and liabilities that result from carryforwards and temporary differences between the financial statement basis and tax basis of assets and liabilities are summarized as follows:

(In thousands)	December 31, 2021	December 31, 2020
Deferred tax assets:		
Tax loss carryforwards	$ 326,763	$ 352,342
Tax credit carryforwards	2,565	3,117
Investment in partnerships	170,610	213,478
Other	17,263	19,377
Gross deferred tax assets	$ 517,201	$ 588,314
Valuation allowance	(504,392)	(573,995)
Total deferred tax assets	$ 12,809	$ 14,319
Deferred tax liabilities:		
Plant and equipment	467	1,219
Convertible Notes	7,008	8,845
Other	5,304	4,218
Total deferred tax liabilities	$ 12,779	$ 14,282
Net deferred tax asset	$ 30	$ 37

The Company provides for deferred income taxes for temporary differences arising from differences between the financial statement and tax basis of assets and liabilities existing at each balance sheet date using enacted tax rates expected to be in effect when the related taxes are expected to be paid or recovered. The Company assesses the need for a valuation allowance against its deferred tax assets through a review of future taxable income, available tax planning strategies, the reversals of temporary differences and considering all available positive and negative evidence.

On the basis of this evaluation, a full valuation allowance has been held against the Company's net deferred tax asset since 2015. Through December 31, 2018, the Company was in a three-year cumulative loss position. Since 2019, the Company has been in a cumulative income position; however, has fluctuated between income and loss for individual years and quarters within each cumulative three-year period.

On March 27, 2020, the Coronavirus Aid, Relief, and Economic Security Act ("CARES Act") was signed into law. CARES Act provided for an acceleration of the refund timing related to remaining AMT credits as initially established under the Tax Cut and Jobs Act of 2017. During 2020, the Company received all outstanding refunds for AMT credits.

For the year ended December 31, 2020, a $76.5 million tax provision was recorded from the addition of valuation allowance offsetting the federal and state net operating losses generated during the year. This was partially offset by an $8.8 million release of valuation allowance through additional paid-in capital (APIC), as a result of the deferred tax liability recorded through APIC related to Convertible Notes. A $574.0 million valuation allowance fully offsets all net deferred tax assets.

For the year ended December 31, 2021, a $69.6 million income tax benefit was recorded from the release of valuation allowance as a result of the federal and state net operating losses utilized during the year.

The Company has gross federal NOL carryforwards for income tax purposes of $1.3 billion at December 31, 2021. Of these carryforwards, approximately $1.1 billion will expire, if not utilized, in various years through 2038. The remaining carryforwards have no expiration; however, they can only be used to offset 80% of the Company's U.S. federal taxable income in any taxable year beginning after December 31, 2021.

The ability to use net operating losses ("NOLs") in existence immediately prior to the Company's emergence from bankruptcy in 2016 has been limited by the "ownership change" under Section 382 of the Internal Revenue Code (the "Code") that occurred as a result of such emergence (the "Emergence Ownership Change"). NOLs generated after the Emergence Ownership Change are generally not subject to the limitations resulting from the Emergence Ownership Change.

A reconciliation of the beginning and ending amounts of gross unrecognized tax benefits follows:

	(In thousands)
Balance at December 31, 2018	$ 39,093
Additions based on tax positions to the current year	2,980
Reductions for tax positions of prior years	(1,970)
Reductions as a result of lapses in the statute of limitations	(374)
Balance at December 31, 2019	39,729
Additions for tax positions related to the current year	1,583
Additions for tax positions related to the prior year	7,918
Reductions for tax positions of prior years	(732)
Reductions as a result of lapses in the statute of limitations	(382)
Balance at December 31, 2020	48,116
Additions based on tax positions to the current year	3,467
Additions for tax positions related to the prior year	3,931
Reductions for tax positions of prior years	(2,868)
Reductions as a result of lapses in the statute of limitations	(3,683)
Balance at December 31, 2021	$ 48,963

If recognized, the entire amount of the gross unrecognized tax benefits at December 31, 2021 would affect the effective tax rate. The Company recognizes interest and penalties related to unrecognized tax benefits in income tax expense. The Company had accrued interest and penalties of $3.8 million and $2.3 million at December 31, 2021 and 2020, respectively. In the next 12 months, $37.5 million gross unrecognized tax benefits are expected to be reduced due to the expiration of the statute of limitations.

The Company is subject to U.S. federal income tax as well as income tax in multiple state jurisdictions. The tax years 2011 through 2021 remain open to examination for U.S. federal income tax matters and 2001 through 2021 remain open to examination for various state income tax matters.

16. Asset Retirement Obligations

The Company's asset retirement obligations arise from the Federal Surface Mining Control and Reclamation Act of 1977 and similar state statutes, which require that mine property be restored in accordance with specified standards and an approved reclamation plan. The required reclamation activities to be performed are outlined in the Company's mining permits. These activities include reclaiming the pit and support acreage at surface mines, sealing portals at underground mines, reclaiming refuse areas and slurry ponds and water treatment.

The following table describes the changes to the Company's asset retirement obligation liability:

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020
Balance at beginning of period (including current portion)	$ 257,764	$ 252,798
Accretion expense	21,748	19,887
Obligations of divested operations	—	(15,455)
Adjustments to the liability from changes in estimates	(26,012)	14,889
Reclamation work completed	(39,047)	(14,355)
Balance at period end	$ 214,453	$ 257,764
Current portion included in accrued expenses	(21,781)	(27,032)
Noncurrent liability	$ 192,672	$ 230,732

As of December 31, 2021, the Company had $500.5 million in surety bonds outstanding and $20.0 million letters of credit to secure reclamation bonding obligations. The Company has posted $0.6 million in cash as collateral related to reclamation surety bonds; this amount is recorded within “Noncurrent assets” on the Consolidated Balance Sheets. Additionally, in the fourth quarter of 2021, the Company contributed $20 million to a fund that will serve to defease the long-term asset retirement obligation for its thermal asset base; this amount is recorded as “Fund for asset retirement obligations” on the Consolidated Balance Sheets. The funds will be utilized for final mine closure reclamation activities.

17. Fair Value Measurements

The hierarchy of fair value measurements assigns a level to fair value measurements based on the inputs used in the respective valuation techniques. The levels of the hierarchy, as defined below, give the highest priority to unadjusted quoted prices in active markets for identical assets or liabilities and the lowest priority to unobservable inputs.

● Level 1 is defined as observable inputs such as quoted prices in active markets for identical assets. Level 1 assets include available-for-sale equity securities, U.S. Treasury securities, and coal swaps and futures that are submitted for clearing on the New York Mercantile Exchange.

● Level 2 is defined as observable inputs other than Level 1 prices. These include quoted prices for similar assets or liabilities in an active market, quoted prices for identical assets and liabilities in markets that are not active, or other inputs that are observable or can be corroborated by observable market data for substantially the full term of the assets or liabilities. The Company’s level 2 assets and liabilities include U.S. government agency securities, coal commodity contracts and interest rate swaps with fair values derived from quoted prices in over-the-counter markets or from prices received from direct broker quotes.

● Level 3 is defined as unobservable inputs in which little or no market data exists, therefore requiring an entity to develop its own assumptions. These include the Company’s commodity option contracts (coal and heating oil) valued using modeling techniques, such as Black-Scholes, that require the use of inputs, particularly volatility, that are rarely observable. Changes in the unobservable inputs would not have had a significant impact on the reported Level 3 fair values at December 31, 2021 and 2020.

The table below sets forth, by level, the Company’s financial assets and liabilities that are recorded at fair value in the accompanying consolidated balance sheet:

	December 31, 2021			
	Total	Level 1	Level 2	Level 3
	(In thousands)			
Assets:				
Investments in marketable securities	$ 14,463	$ 6,003	$ 8,460	$ —
Derivatives	4,214	—	2,995	1,219
Total assets	$ 18,677	$ 6,003	$ 11,455	$ 1,219
Liabilities:				
Derivatives	$ 2,077	$ 313	$ 1,764	$ —

	Fair Value at December 31, 2020			
	Total	Level 1	Level 2	Level 3
	(In thousands)			
Assets:				
Investments in marketable securities	$ 96,765	$ 57,224	$ 39,541	$ —
Derivatives	853	21	832	—
Total assets	$ 97,618	$ 57,245	$ 40,373	$ —
Liabilities:				
Derivatives	$ 3,899	$ 7	$ 3,892	$ —

The Company's contracts with its counterparties allow for the settlement of contracts in an asset position with contracts in a liability position in the event of default or termination. For classification purposes, the Company records the net fair value of all the positions with these counterparties as a net asset or liability. Each level in the table above displays the underlying contracts according to their classification in the accompanying Consolidated Balance Sheet, based on this counterparty netting.

The following table summarizes the change in the fair values of financial instruments categorized as level 3.

(In thousands)	2021	2020
Balance, beginning of period	$ —	$ 61
Realized and unrealized (gains) losses recognized in earnings, net	—	(1,158)
Purchases	1,219	1,235
Issuances	—	(138)
Settlements	—	—
Ending balance	$ 1,219	$ —

No unrealized losses were recognized during the year ended December 31, 2021 related to level 3 financial instruments held on December 31, 2021.

Cash and Cash Equivalents

At December 31, 2021 and 2020, the carrying amounts of cash and cash equivalents approximate their fair value.

Fair Value of Long-Term Debt

At December 31, 2021 and 2020, the fair value of the Company's debt, including amounts classified as current, was $819.5 million and $533.8 million, respectively. Fair values are based upon observed prices in an active market, when available, or from valuation models using market information, which fall into Level 2 in the fair value hierarchy.

18. Capital Stock

Dividends

The Company declared and paid cash dividends per share during the periods presented below:

2021:	Dividends per share	Amount (in thousands)
1st quarter	$ —	$ —
2nd quarter	—	—
3rd quarter	—	—
4th quarter	0.25	3,830
Total cash dividends declared and paid	$ 0.25	$ 3,830

2020:	Dividends per share	Amount (in thousands)
1st quarter	$ 0.50	$ 8,245
2nd quarter	—	—
3rd quarter	—	—
4th quarter	—	—
Total cash dividends declared and paid	$ 0.50	$ 8,245

Future dividend declarations will be subject to ongoing Board review and authorization will be based on a number of factors, including business and market conditions, the Company's future financial performance and other capital priorities.

Share Repurchase Program

During April 2019, the Board of Directors of Arch Resources, Inc. approved an incremental $250 million to the share repurchase program bringing the total authorization to $1,050 million. The Company did not purchase any shares of its common stock under this program for the years ended December 31, 2021 and 2020.

As of December 31, 2021, the Company had repurchased 10,088,378 shares at an average share price of $82.01 per share for an aggregate purchase price of approximately $827 million since inception of the stock repurchase program, and the remaining authorized amount for stock repurchases under this program is $223 million.

The timing of any future share repurchases, and the ultimate number of shares purchased, will depend on a number of factors, including business and market conditions, the Company's future financial performance and other capital priorities. The shares will be acquired in the open market or through private transactions in accordance with the Securities and Exchange Commission requirements. The share repurchase program has no termination date, but may be amended, suspended or discontinued at any time and does not commit the Company to repurchase shares of its common stock. The actual number and value of the shares to be purchased will depend on the performance of the Company's stock price and other market conditions.

Outstanding Warrants

In October 2016, the Company emerged from Chapter 11 which became known as the "Effective Date". On the Effective Date, the Company entered into a warrant agreement (the "Warrant Agreement") with American Stock Transfer & Trust Company, LLC as warrant agent and, pursuant to the terms of the Plan, issued warrants ("Warrants") to purchase up to an aggregate of 1,914,856 shares of Class A Common Stock, par value $0.01 per share, of Arch Resources (the "Class A Common Stock") to certain holders of claims in the Chapter 11 case arising under the cancelled notes. Each Warrant expires on October 5, 2023, and is initially exercisable for one share of Class A Common Stock at an initial exercise price of $57.00 per share. The Warrants are exercisable by a holder paying the exercise price in cash or on a cashless basis, at the election of the holder. The Warrants contain anti-dilution adjustments for stock splits, reverse stock splits, stock dividends, dividends and distributions of cash, other securities or other property, spin-offs and tender and exchange offers by Arch Resources or its subsidiaries to purchase Class A Common Stock at above-market prices.

If, in connection with a merger, recapitalization, business combination, transfer to a third party of substantially all of Arch Resources's consolidated assets or other transaction that results in a change to the Class A Common Stock (each, a "Transaction"), (i) the Transaction is consummated prior to the fifth anniversary of the Effective Date and the Transaction consideration to holders of Class A Common Stock is 90% or more listed common stock or common stock of a company that provides publicly available financial reporting, and holds management calls regarding the same, no less than quarterly ("Reporting Stock") or (ii) regardless of the consideration, the Transaction is consummated on or after the fifth anniversary of the Effective Date, the Warrants will be assumed by the surviving company and will become exercisable for the consideration that the holders of Class A Common Stock receive in such Transaction; *provided* that if the consideration such holders receive consists solely of cash, then upon the consummation of such Transaction, Arch Resources will pay for each Warrant an amount of cash equal to the greater of (i) (x) the amount of cash payable with respect to the number of shares of Class A Common Stock underlying the Warrant *minus* (y) the exercise price per share then in effect *multiplied by* the number of shares of Class A Common Stock underlying the Warrant and (ii) $0.

If a Transaction is consummated prior to the fifth anniversary of the Effective Date in which the Transaction consideration is less than 90% Reporting Stock, a portion of the Warrants corresponding to the portion of the Transaction consideration that is Reporting Stock will be assumed by the surviving company and will become exercisable for the Reporting Stock consideration that the holders of Class A Common Stock receive in such

Transaction, and the portion of the Warrants corresponding to the portion of the Transaction consideration that is not Reporting Stock will, at the option of each holder, (i) be assumed by the surviving company and will become exercisable for the consideration that the holders of Class A Common Stock receive in such Transaction or (ii) be redeemed by Arch Resources for cash in an amount equal to the Black Scholes Payment (as defined in the Warrant Agreement).

During 2021, holders of warrants exercised 20,145 of the warrants, leaving 1,825,423 warrants outstanding at December 31, 2021.

As provided in ASC 825-20, “Financial Instruments,” the warrants are considered equity because they can only be physically settled in Company shares, can be settled in unregistered shares, the Company has adequate authorized shares to settle the outstanding warrants and each warrant is fixed in terms of settlement to one share of Company stock subject only to remote contingency adjustment factors designed to assure the relative value in terms of shares remains fixed.

19. Stock-Based Compensation and Other Incentive Plans

Under the Company’s 2016 Omnibus Incentive Plan (the “Incentive Plan”), 3.0 million shares of the Company’s common stock were reserved for awards to officers and other selected key management employees of the Company. The Incentive Plan provides the Board of Directors with the flexibility to grant stock options, stock appreciation rights, restricted stock awards, restricted stock units, performance stock or units, phantom stock awards and rights to acquire stock through purchase under a stock purchase program (“Awards”). Awards the Board of Directors elects to pay out in cash do not impact the shares authorized in the Incentive Plan. Shares available for award under the plan were 1.8 million at December 31, 2021.

Restricted Stock Unit Awards

The Company may issue restricted stock and restricted stock units, which require no payment from the employee. Restricted stock cliff-vests at various dates and restricted stock units either vest ratably over or vest at the end of the award’s stated vesting period. Compensation expense is based on the fair value on the grant date and is recorded ratably over the vesting period utilizing the straight-line recognition method. The employee receives cash compensation equal to the amount of dividends that would have been paid on the underlying shares.

During 2021, the Company granted both time based awards and performance based awards. The time based awards vest ratably over two, three, and four years, and the performance based awards vest over a three year period. The time based awards’ and non-market based performance awards grant date fair value was determined based on the stock price at the date of grant. The market based performance awards grant date fair value was determined using a Black-Scholes Monte Carlo simulation. An historical volatility of 57% was selected for the performance-based award based on comparator companies, and the three-year risk free rate was derived from yields on U.S. Government bonds. Information regarding the restricted stock units activity and weighted average grant-date fair value follows:

	Time Based Awards		Performance Based Awards	
(Shares in thousands)	Restricted Stock Units	Weighted Average Grant-Date Fair Value	Restricted Stock Units	Weighted Average Grant-Date Fair Value
Outstanding at January 1, 2021	341	$ 64.38	286	$ 71.44
Granted	286	67.21	164	58.74
Forfeited/Canceled	(9)	57.70	(100)	105.95
Vested	(189)	75.27	(9)	135.34
Unvested outstanding at December 31, 2021	429	$ 61.60	341	$ 53.49

The Company recognized expense related to restricted stock units of $20.5 million, $17.4 million and $22.0 million for the years ended December 31, 2021, 2020 and 2019, respectively. As of December 31, 2021, there was $31.4

million of unrecognized share-based compensation expense which is expected to be recognized over a weighted-average period of approximately two years.

20. Workers' Compensation Expense

The Company is liable under the Federal Mine Safety and Health Act of 1969, as subsequently amended, to provide for pneumoconiosis (occupational disease) benefits to eligible employees, former employees and dependents. The Company currently provides for federal claims principally through a self-insurance program. The Company is also liable under various state workers' compensation statutes for occupational disease benefits. The occupational disease benefit obligation represents the present value of the actuarially computed present and future liabilities for such benefits over the employees' applicable years of service.

In October 2019, the Company filed an application with the Office of Workers' Compensation Programs ("OWCP") within the Department of Labor for reauthorization to self-insure federal black lung benefits. In February 2020, the Company received a reply from the OWCP confirming its status to remain self-insured contingent upon posting additional collateral of $71.1 million within 30 days of receipt of the letter. The Company is currently appealing the ruling from the OWCP and has received an extension to self-insure during the appeal process. The Company is evaluating alternatives to self-insurance, including the purchase of commercial insurance to cover these claims.

In addition, the Company is liable for workers' compensation benefits for traumatic injuries which are calculated using actuarially-based loss rates, loss development factors and discounted based on a risk free rate of 1.47%. Traumatic workers' compensation claims are insured with varying retentions/deductibles, or through state-sponsored workers' compensation programs.

Workers' compensation expense consists of the following components:

	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Self-insured occupational disease benefits:			
Service cost	$ 7,796	$ 7,564	$ 6,677
Interest cost[1]	4,439	5,115	4,922
Net amortization[1]	2,363	1,189	—
Total occupational disease	$ 14,598	$ 13,868	$ 11,599
Traumatic injury claims and assessments	3,925	12,922	13,050
Total workers' compensation expense	$ 18,523	$ 26,790	$ 24,649

(1) In accordance with the adoption of ASU 2017-07, "Compensation-Retirement Benefits (Topic 715): Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost," these costs are recorded within Nonoperating expenses in the Consolidated Statements of Operations on the line item "Non-service related pension and postretirement benefit costs."

The table below reconciles changes in the occupational disease liability for the respective period.

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020
Beginning of period	$ 183,001	$ 158,325
Service cost	7,796	7,564
Interest cost	4,439	5,115
Actuarial (gain) loss	(21,245)	19,327
Benefit and administrative payments	(6,406)	(7,330)
	$ 167,585	$ 183,001

The following table provides the assumptions used to determine the projected occupational disease obligation:

(Percentages)	Year Ended December 31, 2021	Year Ended December 31, 2020
Discount rate	2.82	2.48

The higher discount rate decreased obligations by $11.6 million.

Summarized below is information about the amounts recognized in the accompanying Consolidated Balance Sheets for workers' compensation benefits:

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020
Occupational disease costs	$ 167,585	$ 183,001
Traumatic and other workers' compensation claims	70,722	76,953
Total obligations	238,307	259,954
Less amount included in accrued expenses	14,202	15,259
Noncurrent obligations	$ 224,105	$ 244,695

As of December 31, 2021, the Company had $120.7 million in surety bonds, letters of credit and cash outstanding to secure workers' compensation obligations.

As of December 31, 2021, the Company's recorded liabilities include $13.1 million of obligations that are reimbursable under various insurance policies purchased by the Company. These insurance receivables are recorded in the balance sheet line items "Other receivables" and "Other noncurrent assets" for $0.6 million and $12.5 million, respectively.

The following represents expected future payments:

Year	(In thousands)
2022	$ 12,525
2023	12,883
2024	12,997
2025	13,318
2026	13,595
Next 5 years	33,849
	$ 99,167

21. Employee Benefit Plans

Defined Benefit Pension and Other Postretirement Benefit Plans

The Company provides funded and unfunded non-contributory defined benefit pension plans covering certain of its salaried and hourly employees. Benefits are generally based on the employee's age and compensation. The Company funds the plans in an amount not less than the minimum statutory funding requirements or more than the maximum amount that can be deducted for U.S. federal income tax purposes.

The Company also currently provides certain postretirement medical and life insurance coverage for eligible employees. Generally, covered employees who terminate employment after meeting eligibility requirements are eligible for postretirement coverage for themselves and their dependents. The Company offers a subsidy to eligible retirees based on age and years of service at retirement and contain other cost-sharing features such as deductibles and coinsurance. The Company's current funding policy is to fund the cost of all postretirement benefits as they are paid.

On January 1, 2015, the Company's cash balance and excess plans were amended to freeze new service credits for any new or active employees.

Obligations and Funded Status.

Summaries of the changes in the benefit obligations, plan assets and funded status of the plans are as follows:

	Pension Benefits		Other Postretirement Benefits	
(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2021	Year Ended December 31, 2020
CHANGE IN BENEFIT OBLIGATIONS				
Benefit obligations at beginning of period	$ 202,267	$ 217,548	$ 100,898	$ 87,867
Service cost	—	—	341	419
Interest cost	4,334	5,498	2,113	2,392
Settlement gain	(1,768)	(896)	—	—
Curtailments	—	—	—	284
Plan Amendments	(341)	—	—	—
Benefits paid	(27,014)	(38,221)	(5,676)	(6,507)
Other-primarily actuarial (gain) loss	(7,502)	18,338	(18,431)	16,443
Benefit obligations at end of period	$ 169,976	$ 202,267	$ 79,245	$ 100,898
CHANGE IN PLAN ASSETS				
Value of plan assets at beginning of period	$ 199,248	$ 211,802	$ —	$ —
Actual return on plan assets	5,117	23,055	—	—
Employer contributions	148	2,612	5,676	6,507
Benefits paid	(27,014)	(38,221)	(5,676)	(6,507)
Value of plan assets at end of period	$ 177,499	$ 199,248	$ —	$ —
Accrued benefit net asset (obiligation)	$ 7,523	$ (3,019)	$ (79,245)	$ (100,898)
ITEMS NOT YET RECOGNIZED AS A COMPONENT OF NET PERIODIC BENEFIT COST				
Prior service credit	$ 1,091	$ 880	$ —	$ —
Accumulated gain	16,102	10,790	20,657	2,226
	$ 17,193	$ 11,670	20,657	$ 2,226
BALANCE SHEET AMOUNTS				
Noncurrent asset	$ 8,973	$ —	$ —	$ —
Current liability	(150)	(140)	(5,680)	(6,510)
Noncurrent liability	(1,300)	(2,879)	(73,565)	(94,388)
	$ 7,523	$ (3,019)	$ (79,245)	$ (100,898)

Pension Benefits

The accumulated benefit obligation for all pension plans was $170.0 million and $202.3 million at December 31, 2021 and 2020, respectively.

The weighted-average interest credit rate for the cash balance pension plan was 4.25% at December 31, 2021 and 2020.

Significant changes affecting the benefit obligations included the higher discount rate which decreased plan obligations by $8.9 million.

Other Postretirement Benefits

Significant gains and losses affecting the benefit obligations included:

- the higher discount rate decreased plan obligations by $4.0 million;
- the claims cost assumptions were updated decreasing plan obligations by $7.1 million; and
- updated census data resulted in a decrease of plan obligations in the amount of $6.3 million.

Components of Net Periodic Benefit Cost. The following table details the components of pension and postretirement benefit costs (credits):

	Pension Benefits			Other Postretirement Benefits		
(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Service cost	$ —	$ —	$ —	$ 341	$ 419	$ 480
Interest cost[1]	4,334	5,498	8,141	2,113	2,392	3,505
Curtailments	—	—	—	—	—	—
Settlements[1]	(1,768)	(896)	(1,326)	—	—	—
Expected return on plan assets[1]	(7,245)	(8,283)	(10,555)	—	—	—
Amortization of prior service credits[1]	(190)	(112)	(24)	—	—	—
Amortization of other actuarial losses (gains) [1]	—	—	(11)	—	(1,379)	(2,974)
Net benefit cost (credit)	$ (4,869)	$ (3,793)	$ (3,775)	$ 2,454	$ 1,432	$ 1,011

(1) In accordance with the adoption of ASU 2017-07, “Compensation-Retirement Benefits (Topic 715): Improving the Presentation of Net Periodic Pension Cost and Net Periodic Postretirement Benefit Cost,” these costs are recorded within Nonoperating expenses in the Consolidated Statements of Operations on the line item “Non-service related pension and postretirement benefit costs.”

The differences generated from changes in assumed discount rates and returns on plan assets are amortized into earnings over the remaining service attribution periods of the employees using the corridor method.

Assumptions. The following table provides the assumptions used to determine the actuarial present value of projected benefit obligations for the respective periods.

(Percentages)	Year Ended December 31, 2021	Year Ended December 31, 2020
Pension Benefits		
Discount rate	2.67/2.49	2.19/1.96
Other Postretirement Benefits		
Discount rate	2.63	2.17

The following table provides the weighted average assumptions used to determine net periodic benefit cost for the respective periods.

(Percentages)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Pension Benefits			
Discount rate	2.50	2.72	3.65
Expected return on plan assets	4.30	4.65	5.10
Other Postretirement Benefits			
Discount rate	2.17	3.09	4.12

The discount rates used in 2021, 2020 and 2019 were reevaluated during the year for settlements and curtailments. The obligations are remeasured at an updated discount rate that impacts the benefit cost recognized subsequent to the remeasurement.

The Company establishes the expected long-term rate of return at the beginning of each fiscal year based upon historical returns and projected returns on the underlying mix of invested assets. The Company utilizes modern portfolio theory modeling techniques in the development of its return assumptions. This technique projects rates of return that can be generated through various asset allocations that lie within the risk tolerance set forth by members of the Company's pension committee (the "Pension Committee"). The risk assessment provides a link between a pension plan's risk capacity, management's willingness to accept investment risk and the asset allocation process, which ultimately leads to the return generated by the invested assets.

The health care cost trend rate assumed for 2022 is 8.0% and is expected to reach an ultimate trend rate of 4.5% by 2038.

Plan Assets

The Pension Committee is responsible for overseeing the investment of pension plan assets. The Pension Committee is responsible for determining and monitoring appropriate asset allocations and for selecting or replacing investment managers, trustees and custodians. The pension plan's current investment targets are 15% equity and 85% fixed income securities. The Pension Committee reviews the actual asset allocation in light of these targets on a periodic basis and rebalances among investments as necessary. The Pension Committee evaluates the performance of investment managers as compared to the performance of specified benchmarks and peers and monitors the investment managers to ensure adherence to their stated investment style and to the plan's investment guidelines.

The Company's pension plan assets at December 31, 2021 and 2020, respectively, are categorized below according to the fair value hierarchy as defined in Note 17, "Fair Value Measurements":

	Total		Level 1		Level 2		Level 3	
	2021	2020	2021	2020	2021	2020	2021	2020
				(In thousands)				
Equity Securities:[A]								
U.S. small-cap	$ —	$ 2,287	$ —	$ 2,287	$ —	$ —	$ —	$ —
U.S. mid-cap	—	2,890	—	2,890	—	—	—	—
Fixed income securities:								
U.S. government securities[B]	42,273	31,850	41,129	18,705	1,144	13,145	—	—
Non-U.S. government securities[C]	333	1,612	—	—	333	1,612	—	—
Corporate fixed income[D]	81,906	98,357	—	—	81,906	98,357	—	—
State and local government securities[E]	2,514	2,962	—	—	2,514	2,962	—	—
Other investments[G]	23,828	3,519	—	—	23,828	3,519	—	—
Total	$ 150,854	$ 143,477	$ 41,129	$ 23,882	$ 109,725	$ 119,595	$ —	$ —
Assets at net asset value[F]	26,645	55,771						
	$ 177,499	$ 199,248						

(A) Equity securities includes investments in 1) common stock, 2) preferred stock and 3) mutual funds. Investments in common and preferred stocks are valued using quoted market prices multiplied by the number of shares owned. Investments in mutual funds are valued at the net asset value per share multiplied by the number of shares held as of the measurement date and are traded on listed exchanges.

(B) U.S. government securities includes agency and treasury debt. These investments are valued using dealer quotes in an active market.

(C) Non-U.S. government securities includes debt securities issued by foreign governments and are valued utilizing a price spread basis valuation technique with observable sources from investment dealers and research vendors.

(D) Corporate fixed income is primarily comprised of corporate bonds and certain corporate asset-backed securities that are denominated in the U.S. dollar and are investment-grade securities. These investments are valued using dealer quotes.

(E) State and local government securities include different U.S. state and local municipal bonds and asset backed securities, these investments are valued utilizing a market approach that includes various valuation techniques and sources such as value generation models, broker quotes, benchmark yields and securities, reported trades, issuer trades and/or other applicable data.

(F) Investments that are measured at fair value using the net asset value per share practical expedient have not been classified in the fair value hierarchy in accordance with Accounting Standards Update 2015-07. These investments are primarily mutual funds that are highly liquid with no restrictions on ability to redeem the funds into cash.

(G) Other investments include cash, forward contracts, derivative instruments, credit default swaps, interest rate swaps and mutual funds. Investments in interest rate swaps are valued utilizing a market approach that includes various valuation techniques and sources such as value generation models, broker quotes in active and non-active markets, benchmark yields and securities, reported trades, issuer trades and/or other applicable data. Forward contracts and derivative instruments are valued at their exchange listed price or broker quote in an active market. The mutual funds are valued at the net asset value per share multiplied by the number of shares held as of the measurement date and are traded on listed exchanges.

Cash Flows. The Company expects to make no contributions to the pension plans in 2022.

The following represents expected future benefit payments from the plan:

	Pension Benefits	Other Postretirement Benefits
	(In thousands)	
2022	$ 11,245	$ 5,968
2023	11,415	5,884
2024	11,476	5,617
2025	11,181	5,458
2026	10,892	5,275
Next 5 years	46,338	23,632
	$ 102,547	$ 51,834

Other Plans

The Company sponsors savings plans which were established to assist eligible employees in providing for their future retirement needs. The Company's expense, representing its contributions to the plans, was $16.8 million, $17.1 million, and $17.5 million for the years ended December 31, 2021, 2020, and 2019, respectively.

22. Earnings Per Common Share

The Company computes basic net income (loss) per share using the weighted average number of common shares outstanding during the period. Diluted net income (loss) per share is computed using the weighted average number of common shares and the effect of potentially dilutive securities outstanding during the period. Potentially dilutive securities may consist of warrants, restricted stock units or other contingently issuable shares and convertible debt. The dilutive effect of outstanding warrants, restricted stock units and convertible debt is reflected in diluted earnings per share by application of the treasury stock method. The weighted average share impact of warrants, restricted stock units and convertible debt that were excluded from the calculation of diluted shares due to the Company incurring a net loss for the twelve months ending December 31, 2020 were 215,000 shares.

The following table provides the basis for basic and diluted EPS by reconciling the numerators and denominators of the computations:

(In Thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Weighted average shares outstanding:			
Basic weighted average shares outstanding	15,318	15,153	16,218
Effect of dilutive securities	2,261	—	1,080
Diluted weighted average shares outstanding	17,579	15,153	17,298

23. Leases

The Company has operating and finance leases for mining equipment, office equipment and office space with remaining lease terms ranging from less than one year to approximately seven years. Some of these leases include both lease and non-lease components which are accounted for as a single lease component as the Company has elected the practical expedient to combine these components for all leases. As most of the leases do not provide an implicit rate, the Company calculated the Right-of-use ("ROU") assets and lease liabilities using its' secured incremental borrowing rate at the lease commencement date.

As of December 31, 2021 and December 31, 2020, the Company had the following ROU assets and lease liabilities within the Company's Consolidated Balance Sheets:

		December 31, 2021	December 31, 2020
Assets	**Balance Sheet Classification**		
Operating lease right-of-use assets	Other noncurrent assets	$ 14,646	$ 17,069
Financing lease right-of-use assets	Other noncurrent assets	4,215	5,512
Total Lease Assets		$ 18,861	$ 22,581
Liabilities	**Balance Sheet Classification**		
Financing lease liabilities - current	Accrued expenses and other current liabilities	$ 917	$ 860
Operating lease liabilities - current	Accrued expenses and other current liabilities	2,606	2,454
Financing lease liabilities - long-term	Other noncurrent liabilities	4,097	5,014
Operating lease liabilities - long-term	Other noncurrent liabilities	12,713	15,278
		$ 20,333	$ 23,606
Weighted average remaining lease term in years			
Operating leases		5.14	5.99
Finance leases		3.25	4.25
Weighted average discount rate			
Operating leases		5.5%	5.5%
Finance leases		6.4%	6.4%

Information related to leases was as follows:

	Year Ended December 31,	
	2021	2020
	(In thousands)	
Operating lease information:		
Operating lease cost	$ 3,364	$ 3,620
Operating cash flows from operating leases	3,377	3,610
Financing lease information:		
Financing lease cost	$ 1,572	$ 1,179
Operating cash flows from financing leases	1,210	909

Future minimum lease payments under non-cancellable leases as of December 31, 2021 were as follows:

Year	Operating Leases	Finance Leases
	(In thousands)	
2022	$ 3,389	$ 1,210
2023	3,356	1,210
2024	3,200	1,210
2025	3,185	2,111
2026	3,080	—
Thereafter	1,533	—
Total minimum lease payments	$ 17,743	$ 5,741
Less imputed interest	(2,424)	(727)
Total lease liabilities	$ 15,319	$ 5,014

Rental expense, including amounts related to these operating leases and other shorter-term arrangements, amounted to $9.2 million in 2021, $8.6 million in 2020 and $12.0 million in 2019.

Royalties are paid to lessors either as a fixed price per ton or as a percentage of the gross selling price of the mined coal. Royalties under the majority of the Company's significant leases are paid on the percentage of gross selling price basis. Royalty expense, including production royalties, was $127.8 million in 2021, $103.7 million in 2020, and $149.5 million in 2019.

As of December 31, 2021, certain of the Company's lease obligations were secured by outstanding surety bonds totaling $26.0 million.

24. Risk Concentrations

Credit Risk and Major Customers

The Company has a formal written credit policy that establishes procedures to determine creditworthiness and credit limits for trade customers and counterparties in the over-the-counter coal market. Generally, credit is extended based on an evaluation of the customer's financial condition. Collateral is not generally required, unless credit cannot be established. Credit losses are provided for in the financial statements and historically have been minimal.

The Company markets its thermal coal principally to domestic and foreign electric utilities and its metallurgical coal to domestic and foreign steel producers. As of December 31, 2021 and 2020, accounts receivable from sales of thermal coal of $72.8 million and $41.7 million, respectively, represented 22% and 38% of total trade receivables at each date. As of December 31, 2021 and 2020, accounts receivable from sales of metallurgical-quality coal of $251.5 million and $69.1 million, respectively, represented 78% and 62% of total trade receivables at each date.

The Company uses shipping destination as the basis for attributing revenue to individual countries. Because title may transfer on brokered transactions at a point that does not reflect the end usage point, they are reflected as exports,

and attributed to an end delivery point if that knowledge is known to the Company. The Company's foreign revenues by geographical location are as follows:

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Europe	$ 592,702	$ 289,176	$ 537,117
Asia	446,724	138,086	322,029
Central and South America	109,613	56,905	82,476
Africa	—	12,763	18,698
Total	$ 1,149,039	$ 496,930	$ 960,320

The Company is committed under long-term contracts to supply thermal coal that meets certain quality requirements at specified prices. These prices are generally adjusted based on market indices. Quantities sold under some of these contracts may vary from year to year within certain limits at the option of the customer based on their requirements. The Company sold approximately 73.0 million tons of coal in 2021. Approximately 63% of this tonnage (representing approximately 35% of the Company's revenues) was sold under long-term contracts (contracts having a term of greater than one year). Long-term contracts range in remaining life from one to five years.

Third-party sources of coal

The Company purchases coal from third parties that it sells to customers. Factors beyond the Company's control could affect the availability of coal purchased by the Company. Disruptions in the quantities of coal purchased by the Company could impair its ability to fill customer orders or require it to purchase coal from other sources at prevailing market prices in order to satisfy those orders.

Transportation

The Company depends upon barge, rail, truck and belt transportation systems to deliver coal to its customers. Disruption of these transportation services due to weather-related problems, mechanical difficulties, strikes, lockouts, bottlenecks, and other events could temporarily impair the Company's ability to supply coal to its customers. In the past, disruptions in rail service have resulted in missed shipments and production interruptions.

25. Revenue Recognition

ASC 606-10-50-5 requires that entities disclose disaggregated revenue information in categories (such as type of good or service, geography, market, type of contract, etc.) that depict how the nature, amount, timing, and uncertainty of revenue and cash flow are affected by economic factors. ASC 606-10-55-89 explains that the extent to which an entity's revenue is disaggregated depends on the facts and circumstances that pertain to the entity's contracts with customers and that some entities may need to use more than one type of category to meet the objective for disaggregating revenue.

In general, the Company's business segmentation is aligned according to the nature and economic characteristics of its coal and customer relationships and provides meaningful disaggregation of each segment's results. The Company has further disaggregated revenue between North America and Seaborne revenues which depicts the pricing and contract differences between the two. North America revenue is characterized by contracts with a term of one year or longer and typically the pricing is fixed; whereas Seaborne revenue generally is derived by spot or short term contracts with an indexed based pricing mechanism.

	MET	Thermal	Corporate, Other and Eliminations	Consolidated
		(in thousands)		
Year Ended December 31, 2021				
North America revenues	$ 163,833	$ 893,741	$ 1,429	$ 1,059,003
Seaborne revenues	985,300	163,739	—	1,149,039
Total revenues	$ 1,149,133	$ 1,057,480	$ 1,429	$ 2,208,042
Year Ended December 31, 2020				
North America revenues	$ 173,508	$ 772,730	$ 24,424	$ 970,662
Seaborne revenues	468,028	28,902	—	496,930
Total revenues	$ 641,536	$ 801,632	$ 24,424	$ 1,467,592
Year Ended December 31, 2019				
North America revenues	$ 217,381	$ 1,105,801	$ 10,850	$ 1,334,032
Seaborne revenues	773,169	187,151	—	960,320
Total revenues	$ 990,550	$ 1,292,952	$ 10,850	$ 2,294,352

As of December 31, 2021, the Company has outstanding performance obligations for approximately 83.2 million tons of coal for 2022 representing 75.6 million tons of fixed price contracts and 7.6 million tons of variable price contracts. Additionally, the Company has outstanding performance obligations of approximately 65.5 million tons in periods beyond 2022 comprised of 61.5 million tons of fixed price contracts and 4.0 million tons of variable price contracts.

26. Commitments and Contingencies

The Company accrues for cost related to contingencies when a loss is probable and the amount is reasonably determinable. Disclosure of contingencies is included in the financial statements when it is at least reasonably possible that a material loss or an additional material loss in excess of amounts already accrued may be incurred.

The Company is a party to numerous claims and lawsuits with respect to various matters. As of December 31, 2021 and 2020, the Company had accrued $0.1 million and $0.1 million, respectively, for all legal matters, all classified as current. The ultimate resolution of any such legal matter could result in outcomes which may be materially different from amounts the Company has accrued for such matters. The Company believes it has recorded adequate reserves for these matters.

The Company has unconditional purchase obligations relating to purchases of coal, materials and supplies and capital commitments, other than reserve acquisitions, and is also a party to transportation capacity commitments. The future commitments under these agreements total $132.7 million in 2021, and is immaterial thereafter.

27. Segment Information

On December 31, 2020, the Company sold its Viper operation. As a result, the Company revised its reportable segments beginning in the first quarter of 2021 to reflect the manner in which the chief operating decision maker (CODM) views the Company's businesses going forward for purposes of reviewing performance, allocating resources and assessing future prospects and strategic execution. Prior to the first quarter of 2021, the Company had three reportable segments: MET, Powder River Basin (PRB), and Other Thermal. After the divestment of Viper, the Company has three remaining active thermal mines: West Elk, Black Thunder, and Coal Creek. With two distinct lines of business, metallurgical and thermal, the movement to two segments aligns with how the Company makes decisions

and allocates resources. No changes were made to the MET Segment and the three remaining thermal mines are now reported as the “Thermal Segment”. The prior periods have been recasted to reflect the change in reportable segments.

The Company’s reportable business segments are based on two distinct lines of business, metallurgical and thermal, and may include a number of mine complexes. The Company manages its coal sales by market, not by individual mining complex. Geology, coal transportation routes to customers, and regulatory environments also have a significant impact on the Company’s marketing and operations management. Mining operations are evaluated based on Adjusted EBITDA, per-ton cash operating costs (defined as including all mining costs except depreciation, depletion, amortization, accretion on asset retirement obligations, and pass-through transportation expenses, divided by segment tons sold), and on other non-financial measures, such as safety and environmental performance. Adjusted EBITDA is not a measure of financial performance in accordance with generally accepted accounting principles, and items excluded from Adjusted EBITDA are significant in understanding and assessing the Company’s financial condition. Therefore, Adjusted EBITDA should not be considered in isolation, nor as an alternative to net income (loss), income (loss) from operations, cash flows from operations or as a measure of our profitability, liquidity or performance under generally accepted accounting principles. The Company uses Adjusted EBITDA to measure the operating performance of its segments and allocate resources to the segments. Furthermore, analogous measures are used by industry analysts and investors to evaluate the Company’s operating performance. Investors should be aware that the Company’s presentation of Adjusted EBITDA may not be comparable to similarly titled measures used by other companies. The Company reports its results of operations primarily through the following reportable segments: Metallurgical (MET) segment, containing the Company’s metallurgical operations in West Virginia, and the Thermal segment containing the Company’s thermal operations in Wyoming and Colorado.

In November of 2021, the Company sold its equity investment Knight Hawk Holdings, LLC, which had been part of its Corporate, Other and Eliminations grouping. For further information on the sale of Knight Hawk Holdings, LLC, please see Note 4 to the Consolidated Financial Statements, “Divestitures.”

On December 31, 2020, the Company sold its Viper operation, which had been part of its Thermal segment. Viper’s results for the full year of 2020 are included in the Company’s full year 2020 results, and in all preceding periods’ results presented herein. For further information on the sale of Viper to Knight Hawk Holdings, LLC, please see Note 4, “Divestitures” to the Consolidated Financial Statements.

On December 13, 2019, the Company closed on its definitive agreement to sell Coal-Mac LLC, an operating mine complex within the Company’s Thermal coal segment. Coal-Mac is included in the Thermal segment results below up to the date of divestiture. For further information on the divestiture, please see Note 4, “Divestitures” to the Consolidated Financial Statements.

Reporting segment results for the year ended December 31, 2021, the year ended December 31, 2020, and the year ended December 31, 2019 are presented below. The Corporate, Other, and Eliminations grouping includes these charges: idle operations; change in fair value of coal derivatives and coal trading activities, net; corporate overhead; land management activities; other support functions; and the elimination of intercompany transactions.

(In thousands)	MET	Thermal	Corporate, Other and Eliminations	Consolidated
Year Ended December 31, 2021				
Revenues	$ 1,149,133	$ 1,057,480	$ 1,429	$ 2,208,042
Adjusted EBITDA	442,830	175,709	(85,109)	533,430
Depreciation, depletion and amortization	99,171	20,231	925	120,327
Accretion on asset retirement obligation	2,030	17,675	2,043	21,748
Total assets	964,761	205,147	947,252	2,117,160
Capital expenditures	227,802	5,949	11,689	245,440
Year Ended December 31, 2020				
Revenues	$ 641,536	$ 801,632	$ 24,424	$ 1,467,592
Adjusted EBITDA	91,322	34,035	(101,614)	23,743
Depreciation, depletion and amortization	91,202	28,351	1,999	121,552
Accretion on asset retirement obligation	1,943	15,368	2,576	19,887
Total assets	811,605	196,336	714,531	1,722,472
Capital expenditures	269,273	10,719	5,829	285,821
Year Ended December 31, 2019				
Revenues	$ 990,550	$ 1,292,952	$ 10,850	$ 2,294,352
Adjusted EBITDA	305,363	152,023	(94,219)	363,167
Depreciation, depletion and amortization	74,211	35,224	2,186	111,621
Accretion on asset retirement obligation	2,123	14,955	3,470	20,548
Total assets	625,134	361,871	880,751	1,867,756
Capital expenditures	211,718	49,508	5,130	266,356

A reconciliation of segment Adjusted EBITDA to net income (loss):

(In thousands)	Year Ended December 31, 2021	Year Ended December 31, 2020	Year Ended December 31, 2019
Net income (loss)	$ 337,573	$ (344,615)	$ 233,799
Provision for (benefit from) income taxes	1,874	(7)	248
Interest expense, net	23,344	10,624	6,794
Depreciation, depletion and amortization	120,327	121,552	111,621
Accretion on asset retirement obligations	21,748	19,887	20,548
Costs related to proposed joint venture with Peabody Energy	—	16,087	13,816
Asset impairment and restructuring	—	221,380	—
Gain on property insurance recovery related to Mountain Laurel longwall	—	(23,518)	—
Loss (Gain) on divestitures	24,225	(1,505)	13,312
Preference Rights Lease Application settlement income	—	—	(39,000)
Non-service related pension and postretirement benefit costs	4,339	3,884	2,053
Reorganization items, net	—	(26)	(24)
Adjusted EBITDA	$ 533,430	$ 23,743	$ 363,167
EBITDA from idled or otherwise disposed operations	2,469	15,858	12,926
Selling, general and administrative expenses	92,342	82,397	95,781
Other	(9,702)	3,359	(14,488)
Segment Adjusted EBITDA from coal operations	$ 618,539	$ 125,357	$ 457,386

28. Subsequent Event

Through February 16, 2022, the Company repaid $271.3 million of outstanding Term Loans, leaving $9.5 million outstanding. Arch plans to leave the remaining Term Loans outstanding to preserve the facility's terms and conditions, which are incorporated into governing other Arch's indebtedness. After the Term Loan pay-downs, total debt outstanding is approximately $300.0 million (excluding debt issuance costs) on a comparable basis to the December 31, 2021 reported balance. The Company's current cash and liquidity level is sufficient to fund the business and meet both short-term and long-term requirements and obligations, especially in light of reduced capital spending requirements.

Arch plans to implement a new shareholder capital return model in the second quarter of 2022 based on first quarter results. The company expects to pay a variable rate cash dividend quarterly while continuing the existing fixed-rate cash dividend. Any such dividend payments are subject to board approval and declaration.

In advance of the implementing its new shareholder capital return program, the Arch board declared a quarterly cash dividend payment of $0.25 per share payable on March 15, 2022 to stockholders of record on February 28, 2022.

Schedule II

Arch Resources, Inc. and Subsidiaries

Valuation and Qualifying Accounts

	Balance at Beginning of Year	Additions (Reductions) Charged to Costs and Expenses	Charged to Other Accounts	Deductions [a]	Balance at End of Year
			(In thousands)		
Year Ended December 31, 2021					
Reserves deducted from asset accounts:					
Accounts receivable and other receivables	$ 10,636	—	—	—	$ 10,636
Current assets — supplies and inventory	574	1,860	— [b]	185	2,249
Deferred income taxes	573,995	(69,603)	— [c]	—	504,392
Year Ended December 31, 2020					
Reserves deducted from asset accounts:					
Accounts receivable and other receivables	$ 10,636	—	—	—	$ 10,636
Current assets — supplies and inventory	2,216	477	(137)[b]	1,982	574
Deferred income taxes	506,316	76,524	(8,845)[c]	—	573,995
Year Ended December 31, 2019					
Reserves deducted from asset accounts:					
Accounts receivable and other receivables	$ —	—	10,636 [b]	—	$ 10,636
Current assets — supplies and inventory	648	1,737	(35)[b]	134	2,216
Deferred income taxes	530,612	(24,296)	—	—	506,316

(a) Reserves utilized, unless otherwise indicated.
(b) Disposition of subsidiaries.
(c) Recorded through equity.

Exhibit 21.1

Subsidiaries of the Company

The following is a complete list of the direct and indirect subsidiaries of Arch Resources, Inc., a Delaware corporation, including their respective states of incorporation or organization, as of March 1, 2022:

Arch Coal Asia-Pacific PTE. LTD. (Singapore)	**100%**
Arch of Australia PTY LTD (Australia)	**100%**
Arch Coal Australia PTY LTD (Australia)	**100%**
Arch Coal Australia Holdings PTY LTD (Australia)	**100%**
Arch Coal Europe Limited (Europe)	**100%**
Arch Coal Operations LLC (Delaware)	**42.2%**
Catenary Coal Holdings LLC (Delaware)	**100%**
ICG East Kentucky, LLC (Delaware)	**100%**
ICG Eastern, LLC (Delaware)	**100%**
ICG Tygart Valley, LLC (Delaware)	**100%**
Shelby Run Mining Company, LLC (Delaware)	**100%**
Hunter Ridge LLC (Delaware)	**100%**
Bronco Mining Company LLC (West Virginia)	**100%**
Hawthorne Coal Company LLC (West Virginia)	**100%**
Hunter Ridge Coal LLC (Delaware)	**100%**
Juliana Mining Company LLC (West Virginia)	**100%**
King Knob Coal Co. LLC (West Virginia)	**100%**
Marine Coal Sales LLC (Delaware)	**100%**
Melrose Coal Company LLC (West Virginia)	**100%**
Patriot Mining Company LLC (West Virginia)	**100%**
Upshur Property LLC (Delaware)	**100%**
Vindex Energy LLC (West Virginia)	**100%**
White Wolf Energy LLC (Virginia)	**100%**
Wolf Run Mining LLC (West Virginia)	**100%**
The Sycamore Group, LLC (West Virginia)	**50%**
Mingo Logan Coal LLC (Delaware)	**100%**
Arch Coal Sales Company, Inc. (Delaware)	**100%**
Arch Energy Resources, LLC (Delaware)	**100%**
Maidsville Landing Terminal, LLC	**100%**
Arch Land LLC (Delaware)	**57.6%**
Ark Land LLC (Delaware)	**100%**
Western Energy Resources LLC (Delaware)	**100%**
Ark Land KH LLC (Delaware)	**100%**
Ark Land LT LLC (Delaware)	**100%**
Ark Land WR LLC (Delaware)	**100%**
Atlantic Holdings JV LLC (Delaware)	**100%**
Allegheny Land LLC (Delaware)	**100%**
Arch Coal West, LLC (Delaware)	**100%**
Arch Reclamation Services LLC (Delaware)	**100%**
CoalQuest Development LLC (Delaware)	**100%**
Energy Development LLC (Iowa)	**100%**
ICG Eastern Land, LLC (Delaware)	**100%**
ICG Natural Resources, LLC (Delaware)	**100%**
Mountain Gem Land LLC (West Virginia)	**100%**
Mountain Mining LLC (Delaware)	**100%**

Mountaineer Land LLC (Delaware)	**100%**
Otter Creek Coal, LLC (Delaware)	**100%**
Arch Receivable Company, LLC (Delaware)	**100%**
Arch Western Acquisition Corporation (Delaware)	**100%**
Arch Western Acquisition, LLC (Delaware)	**100%**
Arch Western Resources, LLC (Delaware)	**.5%**
Arch Western Resources, LLC (Delaware)	**99.5%**
Arch of Wyoming, LLC (Delaware)	**100%**
Arch Western Bituminous Group, LLC (Delaware)	**100%**
Mountain Coal Company, L.L.C. (Delaware)	**100%**
Thunder Basin Coal Company, L.L.C. (Delaware)	**100%**
Triton Coal Company, LLC (Delaware)	**100%**
ACI Terminal, LLC (Delaware)	**100%**
Ashland Terminal, Inc. (Delaware)	**100%**
International Energy Group, LLC (Delaware)	**100%**
ICG, LLC (Delaware)	**100%**
Arch Coal Group, LLC (Delaware)	**100%**
Arch Coal Operations LLC (Delaware)	**56.8%**
Arch Land LLC (Delaware)	**1.4%**
ICG Beckley, LLC (Delaware)	**100%**
Arch Land LLC (Delaware)	**41%**
Hunter Ridge Holdings, Inc. (Delaware)	**100%**
Arch Coal Operations LLC (Delaware)	**1%**
Meadow Coal Holdings, LLC (Delaware)	**100%**
Prairie Holdings, Inc. (Delaware)	**100%**

Exhibit 23.1

Consent of Independent Registered Public Accounting Firm

We consent to the incorporation by reference in the Registration Statement (Form S-8 No. 333-214373) pertaining to the Arch Resources, Inc. Omnibus Incentive Plan of our reports dated February 16, 2022, with respect to the consolidated financial statements and schedule of Arch Resources, Inc. and subsidiaries, and the effectiveness of internal control over financial reporting of Arch Resources, Inc. and subsidiaries included in its Annual Report (Form 10-K) for the year ended December 31, 2021, filed with the Securities and Exchange Commission.

/s/ Ernst & Young LLP

St. Louis, Missouri

February 16, 2022

WEIR

Weir International, Inc.

Mining, Geology and Energy Consultants

February 15, 2022
Project No. 6260.3 & 6304.3
Via Email: SStewart@archrsc.com

Executive Towers West I 1431 Opus Place,
Suite 210 Downers Grove, Illinois 60515
USA

Tel: 630-968-5400
Fax: 630-968-5401
weir@weirintl.com

Mr. Wm. Scott Stewart Arch Resources, Inc.
1 CityPlace Drive, Suite 300 St. Louis, Missouri
63141

Reference: Consent of Independent Experts Dear Mr. Stewart:

With respect to the SEC filings by Arch Resources, Inc., including but not limited to its Annual Report on Form 10-K for the year ended December 31, 2021, we hereby consent (i) to the use of the information contained the Technical Report Summaries for each of Leer and Black Thunder dated February 2022 (each, a "TRS"), (ii)) to the use of Weir International, Inc.'s name, any quotation from or summarization of the TRS, and (iii) to the filing of the TRS as an exhibit.

We further wish to advise that Weir International, Inc. was not employed on a contingent basis and that at the time of preparation of our report, as well as at present, neither Weir International, Inc. nor any of its employees had, or now has, a substantial interest in Arch Resources, Inc. or any of its affiliates or subsidiaries.

Respectfully submitted,

Weir International, Inc.

Fran X. Taglia President

582 Industrial Park Road, Bluefield, VA 24605-9364 ■ Phone 276.322.5467 www.mma1.com ■ info@mma1.com

CONSENT OF MARSHALL MILLER & ASSOCIATES, INC.

February 14, 2022

Via Email: SStewart@archrsc.com

Mr. Wm. Scott Stewart Arch Resources, Inc.
1 CityPlace Drive, Suite 300 St. Louis, Missouri 63141

Reference: Consent of Independent Experts

With respect to the SEC filings by Arch Resources, Inc., including but not limited to its Annual Report on Form 10-K for the year ended December 31, 2021, we hereby consent (i) to the use of the information contained the Technical Report Summary for Leer South (each, a "TRS"), (ii)) to the use of Marshall Miller & Associates, Inc.'s name, any quotation from or summarization of the TRS, and (iii) to the filing of the TRS as an exhibit.

We further wish to advise that Marshall Miller & Associates, Inc. was not employed on a contingent basis and that at the time of preparation of our report, as well as at present, neither Marshall Miller & Associates, Inc. nor any of its employees had, or now has, a substantial interest in Arch Resources, Inc. or any of its affiliates or subsidiaries.

Respectfully submitted,

By: /s/ Steven A. Keim
Name: Steven A. Keim Title: President
Date: February 14, 2022

Exhibit 24.1

Power of Attorney

KNOW ALL PERSONS BY THESE PRESENTS: That each of the undersigned directors and/or officers of Arch Resources, Inc., a Delaware corporation ("Arch Resources"), hereby constitutes and appoints Paul A. Lang, Matthew C. Giljum and Rosemary L. Klein, and each of them, his or her true and lawful attorneys-in-fact and agents, with full power to act without the other, to sign Arch Resources' Annual Report on Form 10-K for the year ended December 31, 2021, to be filed with the Securities and Exchange Commission under the provisions of the Securities Exchange Act of 1934, as amended; to file such report and the exhibits thereto and any and all other documents in connection therewith, including without limitation, amendments thereto, with the Securities and Exchange Commission; and to do and perform any and all other acts and things requisite and necessary to be done in connection with the foregoing as fully as he or she might or could do in person, hereby ratifying and confirming all that said attorneys-in-fact and agents, or any of them, may lawfully do or cause to be done by virtue hereof.

DATED: February 10, 2022

/s/ Patrick J. Bartels, Jr. Patrick J. Bartels, Jr.	Director
/s/ James N. Chapman James N. Chapman	Director
/s/ John W. Eaves John W. Eaves	Director
/s/ Holly Keller Koeppel Holly Keller Koeppel	Director
/s/ Patrick A. Kriegshauser Patrick A. Kriegshauser	Director
/s/ Paul A. Lang Paul A. Lang	Director
/s/ Richard A. Navarre Richard A. Navarre	Director
/s/ Peifang (Molly) Zhang Peifang (Molly) Zhang	Director

Exhibit 31.1

Certification

I, Paul A. Lang, certify that:

1. I have reviewed this annual report on Form 10-K of Arch Resources, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

/s/ Paul A. Lang

Paul A. Lang

Chief Executive Officer, Director

February 16, 2022

Exhibit 31.2

Certification

I, Matthew C. Giljum, certify that:

1. I have reviewed this annual report on Form 10-K of Arch Resources, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the registrant as of, and for, the periods presented in this report;

4. The registrant's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the registrant and have:

(a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the registrant, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

(b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles;

(c) Evaluated the effectiveness of the registrant's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

(d) Disclosed in this report any change in the registrant's internal control over financial reporting that occurred during the registrant's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the registrant's internal control over financial reporting; and

5. The registrant's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the registrant's auditors and the audit committee of the registrant's board of directors (or persons performing the equivalent functions):

(a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the registrant's ability to record, process, summarize and report financial information; and

(b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

/s/ Matthew C. Giljum

Matthew C. Giljum

Senior Vice President and Chief Financial Officer

February 16, 2022

Exhibit 32.1

Certification of Chief Executive Officer of Arch Resources, Inc. Pursuant to 18.U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002

I, Paul A. Lang, Chief Executive Officer of Arch Resources, Inc., certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that:

(1) the Annual Report on Form 10-K for the year ended December 31, 2021 (the "Periodic Report") which this statement accompanies fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m or 78o(d)); and

(2) information contained in the Periodic Report fairly presents, in all material respects, the financial condition and results of operations of Arch Resources, Inc.

/s/ Paul A. Lang

Paul A. Lang
Chief Executive Officer, Director
February 16, 2022

Exhibit 32.2

Certification of Chief Financial Officer of Arch Resources, Inc. Pursuant to 18.U.S.C. Section 1350, as Adopted Pursuant to Section 906 of the Sarbanes-Oxley Act of 2002

I, Matthew C. Giljum, Senior Vice President and Chief Financial Officer of Arch Resources, Inc., certify, pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002, that:

(1) the Annual Report on Form 10-K for the year ended December 31, 2021 (the "Periodic Report") which this statement accompanies fully complies with the requirements of Section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m or 78o(d)); and

(2) information contained in the Periodic Report fairly presents, in all material respects, the financial condition and results of operations of Arch Resources, Inc.

/s/ Matthew C. Giljum

Matthew C. Giljum
Senior Vice President and Chief Financial Officer
February 16, 2022

Mine Safety and Health Administration Safety Data

We believe that Arch Resources, Inc. ("Arch Resources") is one of the safest coal mining companies in the world. Safety is a core value at Arch Resources and at our subsidiary operations. We have in place a comprehensive safety program that includes extensive health & safety training for all employees, site inspections, emergency response preparedness, crisis communications training, incident investigation, regulatory compliance training and process auditing, as well as an open dialogue between all levels of employees. The goals of our processes are to eliminate exposure to hazards in the workplace, ensure that we comply with all mine safety regulations, and support regulatory and industry efforts to improve the health and safety of our employees along with the industry as a whole.

The operation of our mines is subject to regulation by the Federal Mine Safety and Health Administration (MSHA) under the Federal Mine Safety and Health Act of 1977 (Mine Act). MSHA inspects our mines on a regular basis and issues various citations, orders and violations when it believes a violation has occurred under the Mine Act. We present information below regarding certain mining safety and health violations, orders and citations, issued by MSHA and related assessments and legal actions and mine-related fatalities with respect to our coal mining operations. In evaluating the above information regarding mine safety and health, investors should take into account factors such as: (i) the number of citations and orders will vary depending on the size of a coal mine, (ii) the number of citations issued will vary from inspector to inspector and mine to mine, and (iii) citations and orders can be contested and appealed, and in that process are often reduced in severity and amount, and are sometimes dismissed or vacated.

The table below sets forth for the twelve months ended December 31, 2021 for each active MSHA identification number of Arch Resources and its subsidiaries, the total number of: (i) violations of mandatory health or safety standards that could significantly and substantially contribute to the cause and effect of a coal or other mine safety or health hazard under section 104 of the Mine Act for which the operator received a citation from MSHA; (ii) orders issued under section 104(b) of the Mine Act; (iii) citations and orders for unwarrantable failure of the mine operator to comply with mandatory health or safety standards under section 104(d) of the Mine Act; (iv) flagrant violations under section 110(b)(2) of the Mine Act; (v) imminent danger orders issued under section 107(a) of the Mine Act; (vi) proposed assessments from MHSA (regardless of whether Arch Resources has challenged or appealed the assessment); (vii) mining-related fatalities; (viii) notices from MSHA of a pattern of violations of mandatory health or safety standards that are of such nature as could have significantly and substantially contributed to the cause and effect of coal or other mine health or safety hazards under section 104(e) of the Mine Act; (ix) notices from MSHA regarding the potential to have a pattern of violations as referenced in (viii) above; and (x) pending legal actions before the Federal Mine Safety and Health Review Commission (as of December 31, 2021) involving such coal or other mine, as well as the aggregate number of legal actions instituted and the aggregate number of legal actions resolved during the reporting period.

Mine or Operating Name / MSHA Identification Number	Section 104 S&S Citations (#)	Section 104(b) Orders (#)	Section 104(d) Citations and Orders (#)	Section 110(b)(2) Violations (#)	Section 107(a) Orders (#)	Total Dollar Value of MSHA Assessments Proposed (in thousands) ($)	Total Number of Mining Related Fatalities (#)	Received Notice of Pattern of Violations Under Section 104(e) (Yes/No)	Received Notice of Potential to Have Pattern of Violations Under Section 104(e) (Yes/No)	Legal Actions Initiated During Period (#)	Legal Actions Resolved During Period (#)	Legal Actions Pending as of Last Day of Period(1) (#)
Active Operations												
Vindex Wolf Den Run / 18-00790	—	—	—	—	—	—	—	No	No	—	—	—
Beckley Pocahontas Mine / 46-05252	36	—	—	—	—	151.8	—	No	No	8	6	3
Beckley Pocahontas Plant / 46-09216	—	—	—	—	—	.85	—	No	No	1	1	—
Sentinel Mine / 46-04168	87	4	—	—	—	510	—	No	No	1	2	—
Sentinel Prep Plant / 46-08777	3	—	—	—	—	8.9	—	No	No	—	—	—
Mingo Logan Mountaineer II / 46-09029	102	—	8	—	—	397.3	1	No	No	20	19	5
Mingo Logan Cardinal Prep Plant / 46-09046	5	—	—	—	—	6.7	—	No	No	4	3	1
Mingo Logan Daniel Hollow / 46-09047	—	—	—	—	—	—	—	No	No	—	—	—
Leer #1 Mine / 46-09192	17	—	—	—	—	33.5	—	No	No	1	2	—
Arch of Wyoming Elk Mountain / 48-01694	—	—	—	—	—	—	—	No	No	—	—	—
Black Thunder / 48-00977	1	—	—	—	—	10.1	1	No	No	1	—	1
Coal Creek / 48-01215	2	—	—	—	—	3.2	—	No	No	—	—	—
West Elk Mine / 05-03672	23	—	—	—	—	106.8	—	No	No	—	—	—
Leer #1 Prep Plant / 46-09191	—	—	—	—	—	.63	—	No	No	—	—	—
Wolf Run Mining – Sawmill Run Prep Plant / 46-05544	—	—	—	—	—	—	—	No	No	—	—	—
Vindex Dobbin Ridge Prep Plant / 04607837	—	—	—	—	—	—	—	No	No	—	—	—
Wolf Run – Upshur Complex / 04605823	—	—	—	—	—	.13	—	No	No	—	—	—
Birch River Mine / 04607945	—	—	—	—	—	.13	—	No	No	—	—	—
Wolf Run Mining – Imperial / 46-09115	—	—	—	—	—	—	—	No	No	—	—	—

(1) See table below for additional details regarding Legal Actions Pending as of December 31, 2021

Mine or Operating Name/MSHA Identification Number	Contests of Citations, Orders (as of December 31, 2021)	Contests of Proposed Penalties (as of December 31, 2021)	Complaints for Compensation (as of December 31, 2021)	Complaints of Discharge, Discrimination or Interference (as of December 31, 2021)	Applications for Temporary Relief (as of December 31, 2021)	Appeals of Judges' Decisions or Orders (as of December 31, 2021)
Beckley Pocahontas Mine / 46-05252	—	3	—	—	—	—
Mingo Logan Mountaineer II / 46-09029	—	5	—	—	—	—
Mingo Logan / Cardinal Prep / 49-09046	—	1	—	—	—	—
Thunder Basin / Black Thunder / 48-00977	1	—	—	—	—	—

Notice

Weir International, Inc. (WEIR) was retained by Arch Resources, Inc. (Arch) to prepare this Technical Report Summary (TRS) related to Arch's Leer Mine. This report provides a statement of Arch's coal reserves and resources at its Leer Mine and has been prepared in accordance with the United States Securities and Exchange Commission (SEC), Regulation S-K 1300 for Mining Property Disclosure (S-K 1300) and 17 Code of Federal Regulations (CFR) § 229.601(b)(96)(iii)(B) reporting requirements. This report was prepared for the sole use of Arch and its affiliates and is effective as of December 31, 2021.

This report was prepared by full-time WEIR personnel who meet the SEC's definition of Qualified Persons (QPs) with sufficient experience in the relevant type of mineralization and deposit under consideration in this report.

In preparing this report, WEIR relied upon data, written reports and statements provided by Arch. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by Arch is reasonable and reliable for use in this report.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

WEIR and its personnel are not affiliates of Arch or any other entity with ownership, royalty or other interest in the subject property of this report.

WEIR hereby consents (i) to the use of Arch's Leer Mine coal reserve and resource estimates as of December 31, 2021, (ii) to the use of WEIR's name, any quotation from or summarization of this TRS in Arch's SEC filings, and (iii) to the filing of this TRS as an exhibit to Arch's SEC filings.

Qualified Person: /s/ Weir International, Inc.

Date: February 11, 2022

Address: Weir International, Inc.
1431 Opus Place, Suite 210
Downers Grove, Illinois 60515

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Page

13.0 Mining Methods (Continued)

FIGURES

TABLES

APPENDIX A - EXHIBIT

1.0 EXECUTIVE SUMMARY

Weir International, Inc. (WEIR) was retained by Arch Resources, Inc. (Arch) to prepare a Technical Report Summary (TRS) related to Arch's currently operating Leer Mine. This report has been prepared in accordance with the United States Securities and Exchange Commission (SEC), *Regulation S-K 1300 for Mining Property Disclosure* (S-K 1300) and 17 Code of Federal Regulations (CFR) § 229.601(b)(96)(iii)(B) reporting requirements.

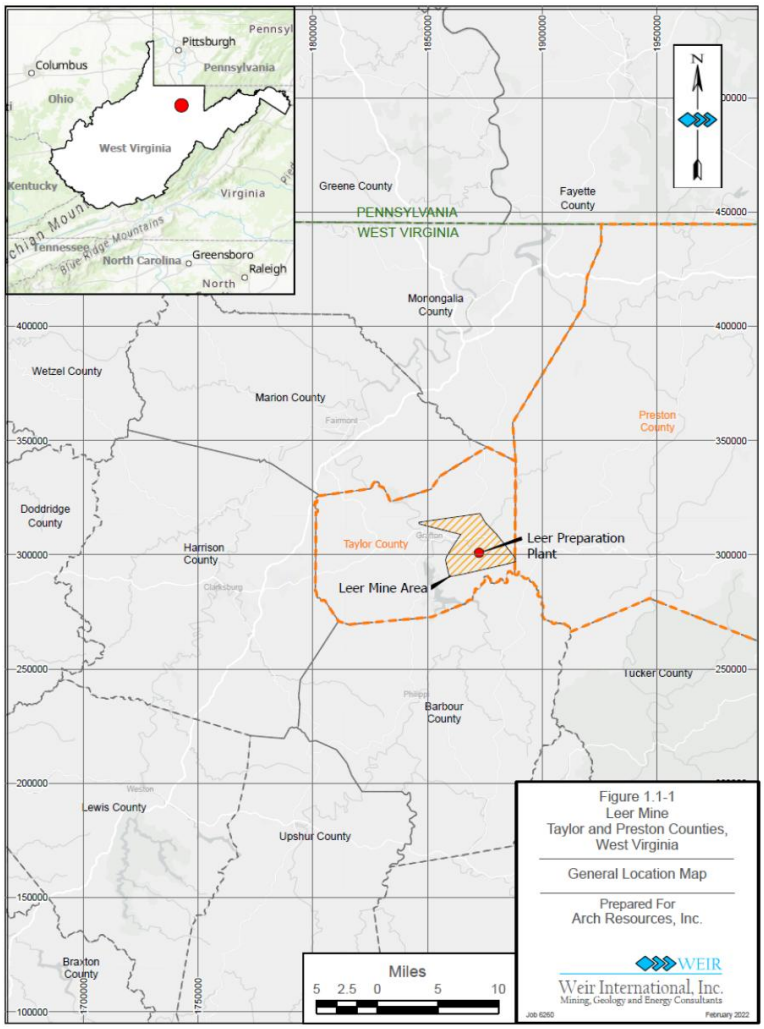
1.1 PROPERTY DESCRIPTION

The Leer Mine is located approximately 25 miles south of Morgantown, West Virginia, primarily in Taylor County, with minimal extension into Preston County, within the Northern West Virginia coal field of the Northern Appalachia Coal Producing (NAPP) Region of the United States (see Figure 1.1-1)

The Leer Mine reserve boundary comprises approximately 26,300 acres. Within that boundary, Arch controls the Lower Kittanning Seam through five coal leases covering approximately 880 acres, with the remaining approximate 25,130 acres of Lower Kittanning Seam owned by Arch through nine coal deeds. An additional 270 acres of the Lower Kittanning Seam are currently uncontrolled by Arch.

The Leer Mine permit area includes approximately 12,635 acres of controlled mineral property (i.e. Arch owns or leases mineral rights). The proposed extension of the Leer Mine permit area will include approximately 5,600 acres of controlled mineral property.

Figure 1.1-1 General Location Map



1.2 GEOLOGICAL SETTING AND MINERALIZATION

The strata of the Tygart Valley River in Taylor, Barbour and Preston Counties, West Virginia consists of Pennsylvanian Age sedimentary strata of the Monongahela Group, the Conemaugh Group and the Allegheny Formation. The Monongahela Group includes the Sewickley, Redstone and Pittsburgh coal seams. The Pittsburgh Seam has been extensively surface and underground mined at higher elevations in the Tygart Valley River region. The Conemaugh Group coal seams include the Elk Lick, Harlem, Bakerstown, and Brush Creek. No known large-scale mining has taken place within the Conemaugh Group coal seams in the Tygart Valley River region. The Allegheny Formation includes the Upper and Lower Freeport, Johnstown Limestone, Upper and Lower Kittanning and the Clarion coal seams. The Upper Freeport, Upper Kittanning, Lower Kittanning, and Clarion seams have been previously mined in the Tygart Valley River region. All other coal seams of the Allegheny Formation in the area occur in limited areal extent and are generally of insufficient thickness for mining.

The principal minable coal seam on the Leer Mine Property is the Lower Kittanning Seam. The Lower Kittanning Seam occurs in a larger area, with a higher seam thickness than all other listed seams in the formation. The Leer Mine is actively mining the Lower Kittanning Seam. The Lower Kittanning Seam reserve extends northeast from Grafton, West Virginia toward Thornton, West Virginia. The reserve area is approximately 6.5 miles in length and approximately 4.0 miles wide. The Lower Kittanning Seam consists primarily of a single horizon of coal with a bone coal parting. Drillholes show seam thickness ranging from 0.0 to 10.5 feet. The seam thins (< 3.0 feet) to the south and east of the Leer Mine LOM Plan and to the north and east of the northern extension of the Leer Mine LOM Plan.

The mineable coal seam is typically low-ash, high thermal content, high volatile A rank bituminous metallurgical coal product. Parting does occur within the property and generally is between one and three feet thick. The parting does not affect the end product since the coal is washed. The seam is generally continuous but is absent in areas outside the Leer Mine LOM Plan. These sub-crops of the Lower Kittanning seam are usually from sandstone washouts.

1.3 EXPLORATION

Historical exploration at the Leer Mine has relied exclusively upon continuous core drilling performed by competent contract drilling companies. Coreholes at the Leer Mine Property are typically 3.76-inch diameter (yielding 2.5-inch diameter core samples). Exploration drilling

provides core samples of roof strata, the coal seam and floor strata. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any holes for poor recovery, as all of the holes within the project area obtained core recovery of at least 90 percent.

Coal seam core samples are sent to laboratories for quality analyses. Caliper, density, gamma, resistivity, and sonic downhole geophysical logs are completed as drill site and hole conditions allow. Each drillhole collar location is surveyed for accurate map coordinate and elevation data.

Typically, three samples of roof and one sample of floor strata from each target seam are taken for strength testing where solid unbroken lengths of core exist. Specific tests ran on core samples include Uniaxial Compressive Strength, Brazilian Indirect Tensile strength, Bulk Density, Specific Gravity, and Point Load index strength. Samples are prepared at a laboratory where the samples are machined into cylinders according to the appropriate American Society for Testing and Materials (ASTM) specifications.

It is WEIR's opinion that the adequacy of sample preparation, security, and analytical procedures for drillholes that were drilled by Arch after acquiring the property is acceptable and that these methods meet typical industry standards.

The adequacy of sample preparation, security, and analytical procedures are generally unknown for drillholes that were drilled prior to Arch acquiring the property in 2011. However, the geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. It is unknown if coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0, however, this legacy drillhole information was included as the samples matched the coal seam intervals and reported similar quality data. Model verifications further support WEIR's high level of confidence that a representative, valid, and accurate drillhole database and geological model has been generated for the Leer Mine that can be relied upon to accurately estimate coal resources and reserves.

1.4 DEVELOPMENT AND OPERATIONS

The Leer Mine is a permitted underground longwall mine that commenced production of metallurgical coal in the fourth quarter of 2011. The longwall mining method has been successfully utilized in the NAPP Region, and in other coal producing regions of the United States, since the 1960s. Longwall mining has the highest mining recovery of modern-day underground mining methods. Longwall mining includes room and pillar continuous mining to develop main entries, longwall headgates and tailgates, and retreat mining production panels.

The Leer Mine is mining the Lower Kittanning Seam and parting interval within the seam utilizing continuous miners to develop longwall panels to be mined using a longwall mining system. The Leer Mine develops longwall districts (sets of adjacent longwall panels) with alphabetic designations. As of September 2021, the Leer Mine had completed mining in 18 longwall panels and was mining the 19th longwall panel (1 Left) in the 6th longwall district.

Historical coal production from the Leer Mine is summarized as follows:

- 4.275 million tons in 2019
- 4.185 million tons in 2020
- 4.370 million tons in 2021

A northern extension of the Leer Mine, Permit Revision 25, was approved on October 20, 2021.

The Leer Mine LOM Plan projects mining through 2035; an expected mine life of 14 years. Arch projects total mine production to range from 2.8 to 5.1 million clean tons when the longwall and continuous miner units are operating (2022 to 2034) and 2.9 million clean tons in 2035 after the continuous miner units cease production in 2034. It is important to note that the LOM plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

All Run-of-Mine (ROM) coal is washed at the Leer Preparation Plant. The preparation plant was designed with two identical processing circuits, which can be operated simultaneously or

one at a time. Each circuit can process 700 ROM tons per hour (tph) of raw coal for a total design feed rate of 1,400 ROM tph, although the preparation plant typically operates at 1,500 ROM tph (750 to 775 ROM tph per circuit). The preparation plant feed rate is adjusted based on the desired product quality, which often results in the preparation plant's processing rate to be higher than the design rate.

The Leer Mine produces a high quality, high volatile metallurgical coal. Historically, the market for metallurgical coal from the Leer Mine has been domestic metallurgical coal consumers and the global seaborne metallurgical coal market. Production from the Leer Mine is a high volatile A coal, as well as a middlings product.

High volatile metallurgical coal contains more than 31 percent volatile matter and is typically represented as high volatile A and high volatile B coal. A third class of high volatile metallurgical coal is referred to as high volatile C, which has calorific, sulfur and petrographic quality considerably less than high volatile A and B metallurgical coals. High volatile metallurgical coal, primarily high volatile A and B coals, serve both the domestic and global seaborne metallurgical coal markets. The Leer Mine sells a high volatile A metallurgical coal.

1.5 MINERAL RESERVE AND RESOURCE ESTIMATE

The Leer Mine coal resources, as of December 31, 2021, summarized below are reported as in-place resources and are exclusive of reported coal reserve tons. Resources are reported in categories of Measured, Indicated and Inferred tonnage and are in accordance with Regulation S-K Item 1302(d), summarized in Table 1.5-1 as follows:

Table 1.5-1 In-Place Coal Resource Tonnage and Quality Estimate as of December 31, 2021

			Average Coal	In-Place Resources (000 Tons)				Coal Quality (Dry Basis) Raw	
Mine Area	Seam	Area (Acres)	Thickness (Feet)	Measured	Indicated	Total	Inferred	Ash (%)	Relative Density (Lbs/CF)
Leer LOM	Lower Kittanning	2,195	4.39	2,400	11,600	14,000	4,900	20.8	90.48

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable underground mine assuming a 3.0 feet minimum seam thickness, a high vol A coal product realizing a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton.
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding

The conversion of resources to reserves at the Leer Mine considers the effects of projected dilution and loss of product coal quality, projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine layout that accommodates the planned mining equipment and provides a safe underground work environment is also considered.

The coal reserve tonnage representing the economically viable tonnage controlled and uncontrolled by Arch, and estimated in accordance with Regulation S-K Item 1302(e), is summarized in Table 1.5-2 as follows:

Table 1.5-2 Recoverable Coal Reserve Tonnage and Quality Estimate as of December 31, 2021

								Coal Quality (Dry Basis)	
								Raw	
Mine Area	Seam	Product Quality	Area (Acres)	Average Coal Thickness (Feet)	Clean Recoverable Tons (000) Reserves			Ash (%)	Relative Density (Lbs/CF)
					Proven	Probable	Total		
Controlled									
Leer LOM	Lower Kittanning	High Vol A	8,910	5.23	18,050	26,300	44,350	19.30	89.91
Uncontrolled									
Leer LOM	Lower Kittanning	High Vol A	270	5.33	590	810	1,400	20.39	90.01
Total			9,180	5.23	18,640	27,110	45,750	19.31	89.91

Notes:

- Clean recoverable Reserve tonnage based on mining recovery of 42 percent for continuous miner mining, 100 percent for longwall mining, modeled preparation plant yield, and a 95 percent preparation plant efficiency
- Mineral Reserves estimated at a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources
- Coal quality listed includes coal that is to be processed into both the middlings product and the metallurgical product and does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR depleted LOM reserve tonnage using actual mine workings through September 30, 2021, and subtracted actual production, reported by Arch, for the remainder of the year to arrive at reserves as of December 31, 2021.

1.6 ECONOMIC EVALUATION

WEIR prepared a Preliminary Feasibility Study financial model in order to assess the economic viability of the Leer Mine LOM Plan. Specifically, plans were evaluated using discounted cash

flow analysis, which consists of annual revenue projections for the Leer Mine LOM Plan. Cash outflows such as capital, including preproduction costs, sustaining capital costs, operating costs, transportation costs, royalties, and taxes are subtracted from the inflows to produce the annual cash flow projections. No adjustments are made for inflation and all cash flows are in 2021 United States dollars. WEIR's study was conducted on an un-levered basis, excluding costs associated with any debt servicing requirements. In its assessment of Net Present Value (NPV), WEIR utilized a discount rate of 10 percent.

The Preliminary Feasibility Study financial model developed for use in this TRS was meant to evaluate the prospects of economic extraction of coal within the Leer Mine resource area. This economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM Plan was outside of the scope of this engagement.

The projected coal sales price is based on a high volatile A benchmark for Hard Coking Coal (HCC) of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

The results of WEIR's Preliminary Feasibility Study demonstrated an after-tax NPV of $1.25 billion for the Leer Mine LOM Plan. Key operational statistics for the LOM Plan, on an after-tax basis, are summarized in Table 1.6-1 as follows:

Table 1.6-1 Key Operating Statistics

	LOM Plan
ROM Tons Produced (000s)	125,207
Clean Tons Produced (000s)	44,195
Preparation Plant Yield (%)	35.3
Marketable Tons Sold (000s)	44,408
	($ Per Ton)
Coal Sales Realization	110.18
Direct Cash Costs	50.94
Other Cash Costs	9.00
Non-cash Costs	12.55
Total Cost of Sales	72.49
Profit / (Loss)	37.69
EBITDA	50.24
CAPEX	6.99

A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales price, preparation plant yield, operating cost, capital expenditures, and discount rate on the base case after-tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed.

The Leer Mine NPV is most sensitive to changes in coal sales price, operating cost, and preparation plant yield. It is less sensitive to changes in discount rate and capital expenditures.

1.7 ENVIRONMENTAL STUDIES AND PERMITTING REQUIREMENTS

As part of the permitting process required by the West Virginia Department of Environmental Protection (WVDEP), numerous baseline studies or impact assessments were undertaken by Arch. These baseline studies or impact assessments included in the permit are summarized as follows:

- Groundwater Inventory
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

The Leer Mine has been issued mining permits and associated NPDES permits by the WVDEP as shown in Table 1.7-1 as follows:

Table 1.7-1 Leer Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

The current permit numbers, bond amounts and reclamation liability for each permit is shown in Table 1.7-2 as follows:

Table 1.7-2 Leer Mine Permitted Area, Reclamation Liability and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [1] ($000)	Bond No.	Bond Amount ($000)
U-2004-06	152.82	10,762	SUR0044268	7,424
O-2017-06	274.89	5,867	1066186	1,155
	427.71	16,629		8,579

[1] Represents the undiscounted cash flows to satisfy reclamation as of July 2020

Arch currently employs approximately 500 personnel at the Leer Mine and is projected to have a maximum employment of 508 personnel during the Leer Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

The Leer Mine is located in a rural and fairly isolated area of West Virginia. Arch received the Greenlands Award from the West Virginia Coal Association for developing, in 2011, the Tygart Valley Community Advisory Panel, which is a non-profit, volunteer entity serving as a forum for open discussion between representatives of the Leer Mine and the residents of the Tygart Valley Area.

The number of environmental violations issued is low for a coal mining operation the size of the Leer Mine.

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts appear to be adequate and reasonable in order to obtain approvals necessary relative to the execution of the Leer Mine LOM Plan.

1.8 CONCLUSIONS AND RECOMMENDATIONS

Among other U.S. underground mines, the Leer Mine is consistently ranked within the top quartile as measured by mine productivity (tons produced per employee hour worked, as reported by MSHA). Additionally, Arch has a long and successful operating history of resource exploration, mine development, and mining operations at the Leer Mine, with extensive exploration data including drillholes, in-mine seam thickness and elevation measurements, and in-mine channel samples supporting the determination of mineral resource

and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

The LOM Plan includes projected mining in a limited number of small areas that will be encountered in later years of the LOM Plan where Arch does not have mineral control. Most of these areas are expected to be acquired by Arch, in adequate time, before the areas are scheduled to be mined. However, if those areas cannot be acquired, adjustments could be made to the scheduled LOM Plan to avoid those areas.

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with Regulation S-K 1300 requirements. There are 14.0 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 45.8 million clean recoverable tons of underground mineable reserves within the Leer Mine as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Leer Mine LOM Plan, considering historical mining performance, historical and projected metallurgical coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring reserves and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

WEIR assessed risks associated with the economic mineability of the Leer Mine to be low to moderate and adds that the majority of the risks can be kept low and/or mitigated with proper planning and monitoring of the mining operations.

WEIR recommends that any future exploration work and mineral property acquisition should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory sample analysis at a 1.40, 1.50 and 1.60 specific gravity to better match the preparation plant specific gravity when processing a metallurgical coal.
- Continue collecting channel samples (include parting).

- Obtain a survey coordinate where a channel sample has been collected.
- Add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the resource area.

Mineral Property

- Acquire or obtain leases of uncontrolled properties at least two years before the projected mining date.

2.0 INTRODUCTION

2.1 REGISTRANT

WEIR was retained by Arch (NYSE: ARCH) to prepare a TRS related to Arch's currently operating Leer Mine. The Leer Mine is located approximately 25 miles south of the city of Morgantown, primarily in Taylor County, with minimal extension into a small area of Preston County, West Virginia (see Figure 1.1-1).

2.2 TERMS OF REFERENCE AND PURPOSE

This TRS was prepared specifically for Arch's Leer Mine. The Lower Kittanning Seam resources at the Leer Mine have been herein classified in accordance with SEC mining property disclosure rules under Subpart 1300 and Item 601 (96)(B)(iii) of Regulation S-K. Unless otherwise stated, all volumes, grades, distances, and currencies are expressed in United States customary units.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

The Leer Mine is a permitted underground longwall mine that commenced production of metallurgical coal in the fourth quarter of 2011. A northern extension of the Leer Mine, Permit Revision 25, was approved on October 20, 2021.

For the Leer Mine, as an established producing mine, this TRS reports both mineral reserves and resources (exclusive of reserves). A proposed extension of the Leer Mine is planned for initial production in 2022 and both mineral reserves and resources (exclusive of reserves) are reported. Supporting the assessment of the economic mineability of reported reserves and

prospects of economically feasible extraction of reported resources, this report includes summary detail of a Preliminary Feasibility Study conducted relative to the Leer Mine.

WEIR's evaluation of coal reserves and resources was conducted in accordance with Regulation S-K 1300 definitions for Mineral Resource, Mineral Reserve and Preliminary Feasibility Study as follows:

- Mineral Resource is a concentration or occurrence of material of economic interest in or on the earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.
- Mineral Reserve is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the Qualified Person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.
- Preliminary Feasibility Study is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a Qualified Person has determined (in the case of underground mining) a preferred mining method, or (in the case of surface mining) a pit configuration, and in all cases has determined an effective method of mineral processing and an effective plan to sell the product.

2.3 SOURCES OF INFORMATION AND DATA

The primary information used in this study was obtained from the following sources:

- Geological data that was exclusively provided by Arch geology and engineering staff. The geological data includes drillhole information such as driller's logs, geologist's logs, both full and partial scans of geophysical logs, survey data, coal quality laboratory certificates, and MS Excel™ (Excel) versions of drillhole survey, lithology and quality

data. Additionally, WEIR was provided with modeled coal seam floor elevations and seam thickness contours, topography contours, in-mine seam measurement thicknesses, mine channel quality samples, and other base geological data.

- Mineral and surface ownership maps, and supplemental files were provided exclusively by Arch Land LLC, a subsidiary of Arch.
- Site visits by WEIR Qualified Persons (QPs) on August 17, 2021.
- Interviews between WEIR personnel and Arch personnel including
  - Ø V.P. of Geology & Exploration
  - Ø Manager of Geology, East
  - Ø Director of Financial Analysis and Support
  - Ø Mine Manager - Leer Mine
  - Ø Manager of Engineering - Leer Mine
  - Ø Business Manager - Leer Mine
  - Ø Maintenance Manager - Leer Mine
- Historical production, productivity, staffing levels, operating costs, capital expenditures, and coal sales revenue provided by Arch.
- Life of Mine (LOM) projections and cost model provided by Arch.
- Coal processing and handling facilities plot plans and flow sheets.
- Health, safety, and environmental issues discussed during interviews between WEIR personnel and Arch personnel.
- Current mine permits, in addition to recent permit revisions and renewals provided by Arch.
- Current and projected mine plans, including production, productivity, operating costs, and capital expenditures required to sustain projected levels of production for the Leer Mine, provided by Arch, and which were all reviewed for reasonableness by WEIR.
- Market outlook and coal sales price projections provided by Arch
- Projected reclamation costs for mine closure activities provided by Arch.

A detailed list of all data received and reviewed for this study is provided in Sections 24.0 and 25.0 of this TRS.

2.4 DETAILS OF THE PERSONAL INSPECTION OF THE PROPERTY

WEIR personnel previously visited the Leer Mine on November 24, 2014. WEIR has also performed numerous annual audits of the Leer Mine reserves for Arch's annual SEC 10K filings.

WEIR initially held discussions with mine management on February 18, 2021, to review questions WEIR had relative to the property's geology, mine plans and operations. The management discussions included key topics as follows:

- Geology
- Property
- Infrastructure
- Mine Plan, Production and Productivity
- Preparation Plant
- Operating Costs and Capital expenditures
- Marketing
- Environmental and Compliance
- Risks and Uncertainties

Subsequently. WEIR personnel visited the Leer Mine on August 17, 2021. Areas of the mine visited included the following:

- Mine office and Bathhouse
- Warehouse
- Preparation Plant and Stockpiles
- Rail Loadout
- Refuse Impoundment
- Underground areas, including the 5 Right longwall, 4 East Mains (MMUs 001 and 005), 3 Left Gateroad (MMU 004), 4 Left Gateroad (MMU 002), and North Mains

In addition to observance of mine infrastructure, surface facilities and mining conditions, WEIR discussed the Leer Mine LOM Plan with mine management personnel.

2.5 PREVIOUS TRS

This TRS is the initial TRS to be filed related to the Leer Mine.

3.0 PROPERTY DESCRIPTION

3.1 PROPERTY LOCATION

The Leer Mine is located approximately 25 miles south of Morgantown, West Virginia, primarily in Taylor County, with minimal extension into Preston County, within the Northern West Virginia coal field of the NAPP Region of the United States (see Figure 1.1-1). The USGS 7.5-minute quadrangle map sheets are Fairmont East, Gladesville, Grafton, and Thornton.

3.2 PROPERTY AREA

The Leer Mine permit area includes approximately 12,635 acres of controlled mineral property. The proposed extension of the Leer Mine permit area will include approximately 5,600 acres of controlled mineral property.

The Leer Mine's surface facilities are located within the Leer Mine permit area, near central area of the mid-north boundary of the permit. The surface facilities include mine administration, engineering and operations offices, coal preparation plant, rail loadout, mine maintenance facilities, warehouse facilities, parking lots, preparation plant waste disposal, settling ponds, and the Leer Mine slope portal access. The total disturbed area for the Leer Mine surface facilities is approximately 200 acres.

3.3 PROPERTY CONTROL

The Leer Mine reserve boundary comprises approximately 26,300 acres. Within that boundary, Arch controls the Lower Kittanning Seam through five coal leases covering approximately 880 acres, with the remaining approximate 25,130 acres of Lower Kittanning Seam owned by Arch through nine coal deeds. An additional 270 acres of the Lower Kittanning Seam are currently uncontrolled by Arch. A table that describes the various property control contracts is shown in Table 3.3-1. Note that each individual contract may include more than one type of property control.

Table 3.3-1 Property Control

Document Type	Quantity
Coal Leases	10
Coal Deeds	12
Surface Leases	1
Surface Deeds	53
Right of Entry	1
Surface Use Agreement	1
Options to Purchase Property	5
Subsidence Rights	20

3.4 MINERAL CONTROL

Coal seam mineral rights are controlled by 10 coal leases and 12 coal deeds. All 10 leases have a minimum annual royalty payment ranging from $1,570 to $58,269. Each lease has a minimum royalty amount that must be paid annually in order to maintain the lease, with the exception of one lease, which has a one-time only minimum royalty payment. Arch's production royalty rates range from 5 percent to 10 percent of the GSP. Three leases have additional annual rental agreements. There are two tracts within Coal Deed LN-001-01 that are not 100 percent controlled; one tract is 92 percent controlled and the other is 83 percent controlled. One tract within Coal Deed TV-036 is 50 percent controlled. These three tracts total approximately 220 acres. The details of the mineral control contracts are listed in Table 3.4-1.

Table 3.4-1 Mineral Control

Arch Land File Number	Document Type	Seams	Expiration Date [1]
D-1	Deed	Lower Kittanning	N/A
L-1	Coal Lease	Lower Kittanning	Upon Exhaustion
L-2	Coal Lease	All seams	Upon Exhaustion
L-3	Lease	Upper Freeport and all seams below	Upon Exhaustion
D-2	Deed	All seams	N/A
D-3	Deed	All seams	N/A
D-4	Deed	All seams	N/A
D-5	Deed	All seams	N/A
D-6	Deed	All seams	N/A
D-7	Deed	All seams	N/A
D-8	Deed	All seams	N/A
D-9	Deed	All seams	N/A
D-10	Deed	All seams	N/A
Arch Land File Number	Document Type	Seams	Expiration Date [1]
L-4	Coal Lease	All seams	Upon Exhaustion
L-5	Coal Lease	All seams	Upon Exhaustion
L-6	Coal Lease	All seams	Upon Exhaustion
L-7	Coal Lease	All seams	Upon Exhaustion
L-8	Coal Lease	All seams	Upon Exhaustion
L-9	Coal Lease	All seams	Upon Exhaustion
L-10	Coal Lease	All seams	Upon Exhaustion
D-11	Deed	All seams	N/A
D-12	Deed	All seams	N/A

[1] Expiration dates on leases can be extended

3.5 SIGNIFICANT PROPERTY ENCUMBRANCES

The majority of the Leer Mine LOM Plan area is permitted. A permit revision to include the northern extension projected mining areas was submitted on May 3, 2021 to the WVDEP and was approved on October 20, 2021. Future permit revisions will be needed at the Leer Mine to add underground mining area and associated surface area for bleeder shaft sites. Small, isolated uncontrolled properties, primarily within the northern extension will need to be acquired, by

lease or purchase, to avoid the need to revise the mine plan. The tons associated with these uncontrolled properties have been included in the reserve estimates.

One property lease at the Leer Mine requires a payment to be made based on transport of other coal (i.e. coal not mined within that lease) across the lease boundary (wheelage). Wheelage payments related to mining longwall panels 18C through 26 began in October 2021 and are estimated to continue through February 2027.

Approximately 270 acres (2.9 percent) of uncontrolled property exist within the Leer Mine LOM Plan Reserve area. Approximately 11 acres (0.5 percent) of uncontrolled property exist within the Leer Mine exclusive resource area. Acquisition of these relatively small blocks of mineral resource is on-going by Arch and not dissimilar to other mine's property control tasks involving relatively small areas. Uncontrolled properties within a mine plan are not uncommon and are mitigated as needed or, in rare cases, the mine plans are adjusted to avoid the uncontrolled properties.

WEIR is not aware of any obstacles to obtaining necessary property rights, and reasonably believes that the chances of obtaining such rights in a timely manner are highly likely. Given prior successes in Arch's property acquisition efforts, and relatively small tonnage impacts for unsuccessful reserve property acquisitions, this risk appears relatively low, as well.

A list of Arch's permits is shown in Table 3.5-1, with a more detailed description of permits discussed in Section 17.3.

Table 3.5-1 Permit List

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

A permit amendment will be required, by the fourth quarter of 2027, for Permit O-2017-06 to add the Rocky Branch Impoundment. In addition to the permitting actions, reclamation surety bonds will be required in accordance with West Virginia state regulations.

The Leer Mine does not have a history of significant regulatory fines or violations. The last violation for Permit Number U-2004-06 was on June 4, 2015, with an assessed fine of $700, and the last violation for Permit Number O-2017-06 was on October 9, 2013, with no fine assessed.

3.6 SIGNIFICANT PROPERTY FACTORS AND RISKS

Given Arch's controlled interests at the Leer Mine, which relate to property that is held, by and large, by Arch and private individuals, WEIR assesses there are no significant issues affecting access to the coal interests or the ability of Arch to execute the Leer Mine LOM Plan.

3.7 ROYALTY INTEREST

Arch holds no royalty or similar interest in property which is owned or operated by another party.

4.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

4.1 TOPOGRAPHY, ELEVATION, AND VEGETATION

The Leer Mine Property is located on the Appalachian Plateau. The topography of the property consists of steep slopes rising from the Tygart Valley River and its associated tributaries. The Tygart Valley River extends from Pocahontas County, West Virginia through Randolph, Barbour, Taylor, and Marion Counties. The property is located off the Three Fork Creek tributary of the Tygart Valley River near Grafton, West Virginia. The upper elevations consist of rolling terrain, with scattered knobs of higher elevation. The terrain drops off from the higher elevations, with steep slopes down to Three Fork Creek to the north, Tygart Lake to the west and south, and Little Sandy Creek to the southeast and east. There are scattered areas of relatively flat lying pastureland on the river and stream floodplain terraces. Maximum relief of the property is approximately 800 feet. Elevation ranges from 1,004 feet on Three Fork Creek to 1,872 feet on an isolated knob west of Little Sandy Creek, (USGS Thornton quadrangle). Topography and other features of the area are shown on Figure 7.5-1.

The Leer Mine Property consists mostly of unmanaged forestland and scattered pastureland. The forestland consists of typical West Virginia forest, with Oak/Hickory as the dominant forest-type group and a lesser percentage of the Maple/Beech/Birch forest-type group, (USDA Resource update FS-123).

4.2 PROPERTY ACCESS

The main road near the mine surface facilities is US Route 50, which runs east/west and is less than a mile north of the Leer Mine facilities. The mine access road (Tygart Drive) is approximately two miles west of the small town of Thornton, West Virginia, and approximately three miles east of Grafton, West Virginia. The nearest larger towns are Morgantown, West Virginia, located approximately 25 miles to the north, and Bridgeport, West Virginia, located approximately 16 miles to the west of the property.

The Mountain Subdivision rail line, owned and operated by the CSX Railroad (CSX), passes directly by the mine surface facilities, and has a separate rail loadout spur for the Leer Mine. There are dual main rail lines adjacent to the mine, which helps reduce rail line congestion.

The Mountain Subdivision rail line extends from Cumberland, Maryland to Grafton, West Virginia. CSX also owns and operates a rail yard at Grafton, West Virginia.

Three Fork Creek, to the north and adjacent to the rail lines, runs east to west. The Tygart Valley River runs from south to north along the western side of the Leer Mine. Tygart Lake is partially within the Leer Mine permit area, along the western boundary of the permit. The surrounding waterways are not navigable for commercial traffic.

The nearest airport is the North Central West Virginia Airport (CKB), which is located in Bridgeport, West Virginia. The North Central West Virginia Airport is 15.6 miles from Grafton, West Virginia. The Morgantown Municipal Airport (MGW) is located in Morgantown, West Virginia, 29.6 miles from the Leer Mine Property.

4.3 CLIMATE AND OPERATING SEASON

The climate associated with the Leer Mine Property is classified as a humid continental, characterized by hot, humid summers and moderately cold winters. Climate conditions vary greatly in the state of West Virginia due to influence of the rugged topography. Average high temperatures range from 82 to 87 degrees Fahrenheit in the summer, with average temperatures ranging from 15 to 25 degrees Fahrenheit in winter. Average yearly rainfall measured in Grafton, West Virginia is 48 inches per year. The Leer Mine currently operates year-round, regardless of weather conditions.

4.4 INFRASTRUCTURE

Power

Electrical power for the Leer Mine is provided by FirstEnergy Corp. subsidiary Mon Power through a 138 kV transmission line. A contract with Mon Power provides electrical power under Rate Schedule K.

Water

The Tygart Valley River lies to the west of the Leer Mine Property. The Tygart Valley River is not navigable for commercial traffic. Over half of the water required for mine operations such as mine dust suppression and preparation plant make up water is provided by recycling. The remainder is provided by a pump station installed beside Three Fork Creek, a tributary of Tygart Valley River, and is pumped to a million-gallon head tank. There is no contract or

monthly charge for the water from Three Fork Creek. Potable water for the facilities is obtained from the Taylor County Public Service District at an average monthly charge of $12,000.

Personnel

The northern West Virginia area surrounding the Leer Mine has a long history of underground coal mining and attracting mining personnel with qualified skills has not been an issue. The Leer Mine is projected to employ a maximum of 508 personnel over the LOM Plan and the Leer Mine employed approximately 501 personnel at the end of January 2021. The hourly labor force remains non-union and no change in this labor arrangement is anticipated in the short term.

Supplies

Supplies for the mining operations are available from multiple vendors that service the coal industry in the NAPP Region. The main vendors utilized by Arch to supply the Leer Mine include United Central Industrial Supply, Komatsu America Corp. (Joy Global), Jennmar Corporation, Strata Worldwide, Polydeck, Chemstream Inc., Richwood Industries, Inc., Conn-weld Industries, LLC, Coalfield Services Inc., Minova Global, Airtite Mine Products, LLC, Schauenburg Flexadux Corp., Contitech USA Inc., Greer Industries, Inc., and American Block Co., Inc.

5.0 HISTORY

5.1 PREVIOUS OPERATIONS

Prior to the development of the Leer Mine, there was very little mining that occurred on the property. A small underground coal mine operated by the Thornton Fire Brick Company was located in the Upper Freeport Seam to the southeast of Thornton, West Virginia. This mine was located off of Three Fork Creek and operated in the early 1900s. The Thornton Fire Brick Company also operated a surface mine or "clay pit" near Thornton, West Virginia, mining fireclay for brickmaking in the early 1900s. Available maps show an underground mine, of limited extent, in the Lower Kittanning Seam to the south of the Leer Mine on the east side of Frog Run. Available data shows this as Sterling Coal Company's Cecil coal mine, with mining shown to have occurred in the early 1900s.

5.2 PREVIOUS EXPLORATION AND DEVELOPMENT

Prior to Arch's control of the property in 2011, previous exploration included 153 continuous core holes drilled in proximity to the Leer Mine Property. Prior exploration activity dates back to 1922, with a list of prior companies conducting exploration, number of core holes drilled, seam thickness range, laboratories utilized for quality analysis, and dates are listed in Table 5.2-1.

Table 5.2-1 Previous Exploration

Company	Drill Holes	Seam Thickness (feet)	Quality Laboratory	Year Drilled
Mohawk Smokeless Coal Company	1	5.3	None	Unknown
Koppers Company	8	0.0 to 7.9	Unknown	1922
Eastern Gas & Fuel Associates	2	5.4	Eastern Associated Coal Corp.	1960
Eastern Gas & Fuel Associates	39	0.0 to 8.9	Eastern Associated Coal Corp.	1964
Tygart West Inc./Atlantic Richfield Co.	4	4.1 to 5.4	Unknown	1974
Hillman Coal Company	17	0.0 to 7.3	Unknown	1980
Eastern Associated Coal Corp.	3	3.9 to 4.7	Eastern Associated Coal Corp.	1982
Tygart West Inc./Anaconda Minerals Co	29	3.9 to 9.7	Colorado School of Mines	1982
Anker Energy [(1)]	1	4.2	Unknown	1986
Unkown (M93-14) [(1)]	1	4.2	None	1993
International Coal Group	39	0.0 to 8.4	SGS	2005
International Coal Group	8	2.8 to 5.8	SGS	2006
Patriot Coal (GUFDEP4) [(1)]	1	4.8	None	Unknown

[(1)] No documentation available

6.0 GEOLOGICAL SETTING, MINERALIZATION, AND DEPOSIT

6.1 REGIONAL, LOCAL, AND PROPERTY GEOLOGY

6.1.1 Regional Geology

The strata of the Tygart Valley River in Taylor, Barbour and Preston Counties, West Virginia consists of Pennsylvanian Age sedimentary strata of the Monongahela Group, the Conemaugh Group and the Allegheny Formation (see Figure 6.3-1). The gently dipping, stratiform or layered strata consists of shale, sandstone, claystone, fireclay, and coal seams. At present, economic sedimentary deposits are limited to coal seams of the Tygart Valley River. Limited scale mining of fireclay occurred in several areas near Grafton, West Virginia during the early 1900s.

The Monongahela Group includes the Sewickley, Redstone and Pittsburgh coal seams. The Pittsburgh Seam has been extensively surface and underground mined at higher elevations in the Tygart Valley River region. The Conemaugh Group coal seams include the Elk Lick, Harlem, Bakerstown, and Brush Creek. No known large-scale mining has taken place within the Conemaugh Group coal seams in the Tygart Valley River region. The Allegheny Formation includes the Upper and Lower Freeport, Johnstown Limestone, Upper and Lower Kittanning and the Clarion coal seams. The Upper Freeport, Upper Kittanning, Lower Kittanning, and Clarion seams have been previously mined in the Tygart Valley River region. All other coal seams of the Allegheny Formation in the area occur in limited areal extent, and are generally of insufficient thickness for mining.

6.1.2 Local Geology

The Monongahela Group strata is not present on the Leer Mine Property due to the lower elevations of the property. The strata present on the property consists of the Conemaugh Group and the Allegheny Formation. The Conemaugh Group coal seams consist of the Harlem, Bakerstown, and Brush Creek. All coal seams of the Conemaugh Group are thin and discontinuous. The Allegheny Formation coal seams consist of the Upper and Lower Freeport, Upper and Lower Kittanning, and Clarion. The Upper and Lower Freeport, Upper Kittanning and Clarion coal seams are discontinuous and of limited extent on the Leer Mine Property.

6.1.3 Property Geology

The principal minable coal seam on the Leer Mine Property is the Lower Kittanning Seam. The Lower Kittanning Seam occurs in a larger area, with a higher seam thickness than all other listed seams. The Leer Mine is actively mining the Lower Kittanning Seam. The Lower Kittanning Seam reserve extends northeast from Grafton, West Virginia toward Thornton, West Virginia. The reserve area is approximately 6.5 miles in length and approximately 4.0 miles wide. The Lower Kittanning Seam consists primarily of a single horizon of coal with a bone coal parting. Drillholes show seam thickness ranging from 0.0 to 10.5 feet. The seam thins (< 3.0 feet) to the south and east of the Leer Mine LOM Plan and to the north and east of the northern extension of the Leer Mine LOM Plan. The mineable coal seam is typically low-ash, high thermal content, high volatile A bituminous metallurgical coal product. Parting does occur within the property and generally is between one and three feet thick. The parting does not affect the end product since the coal is washed. The seam is generally continuous but is absent in areas outside the Leer Mine LOM Plan. The Lower Kittaning Seam is thin or missing in areas adjacent to the Leer Mine reserve. The missing coal areas are due to non-deposition of the Lower Kittaning coal seam.

6.2 MINERAL DEPOSIT TYPE AND GEOLOGICAL MODEL

The Leer Mine reserve is a relatively flat lying, sedimentary deposit of Pennsylvanian Age. The Leer Mine is actively mining a single coal seam, the Lower Kittanning.

Exploration consists of core drilling for the Lower Kittanning Seam carried out each year in advance of mining, to refine the reserve boundary and to define limits of the mine plan. For internal purposes, Arch models the reserve using the Geovia Minex® mine planning software package, completing model updates subsequent to each phase of exploration drilling. WEIR modeled the reserves and resources using Datamine MineScape® Stratmodel geological modeling software. The WEIR model is discussed in more detail in Section 9.1.

6.3 STRATIGRAPHIC COLUMN AND CROSS SECTION

Figure 6.3-1 and Figure 6.3-2 show the stratigraphic column and the Lower Kittanning Seam cross section related to the Leer Mine.

Figure 6.3-1 Stratigraphic Column

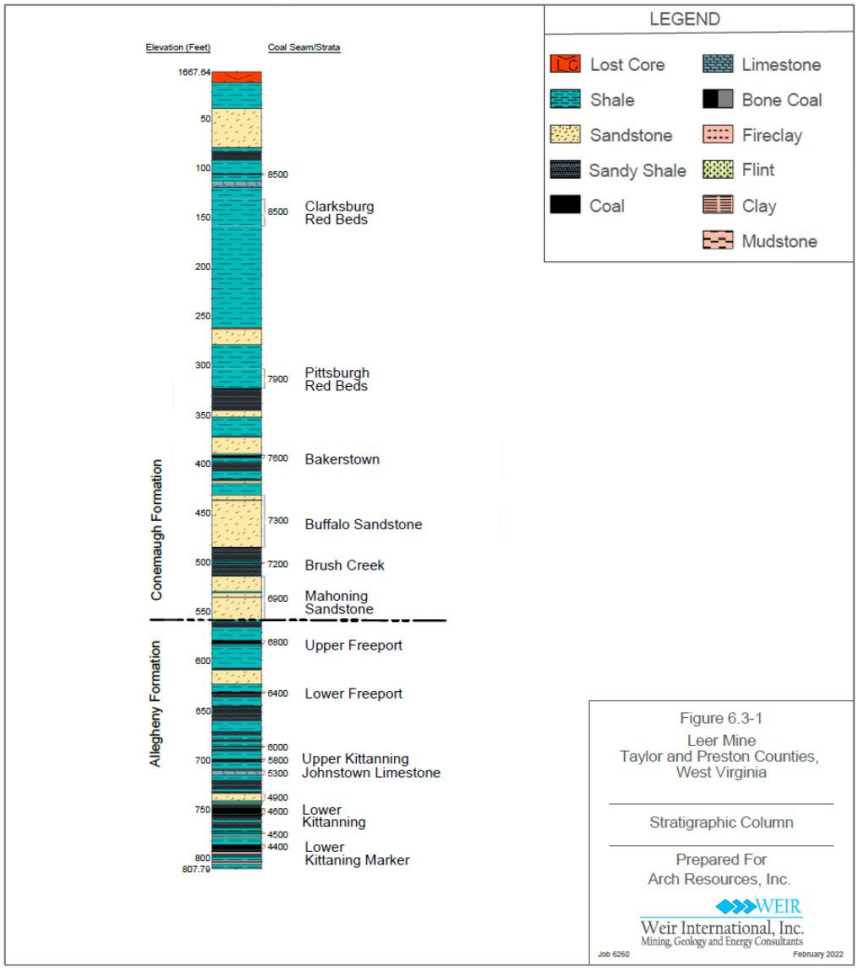
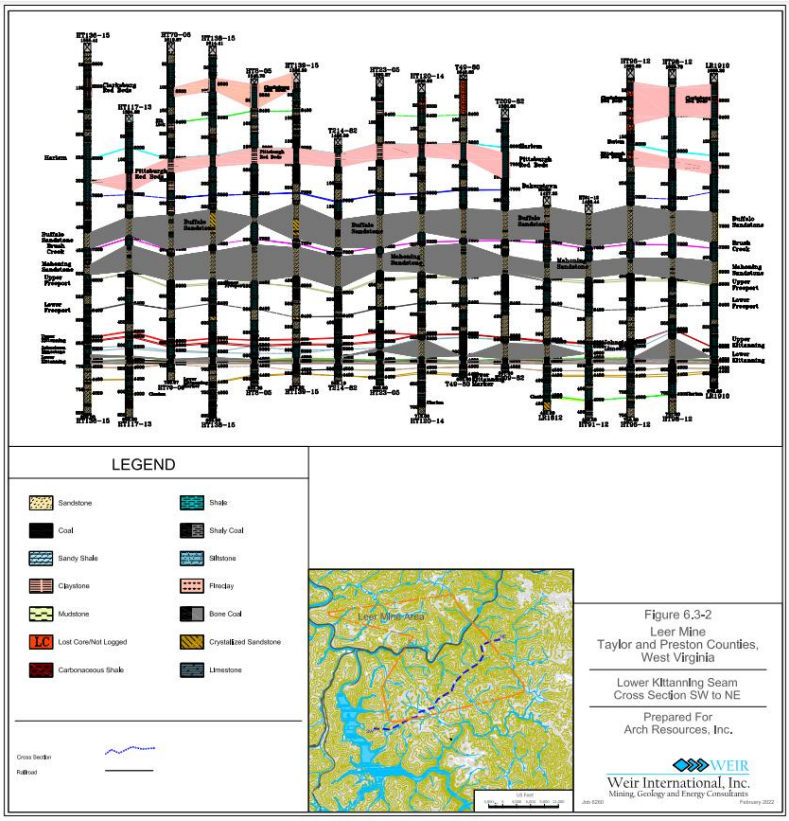


Figure 6.3-2 Lower Kittanning Seam Cross Section SW to NE



7.0 EXPLORATION

7.1 NON-DRILLING EXPLORATION

Drilling has served as the primary form of exploration carried out on the Leer Mine Property. In addition to the exploration, mine measurements are taken by Arch, at intervals between 100 and 300 feet throughout the Leer Mine underground mine workings. A total of 1,505 of these mine measurements were recorded. Arch also provided details of 47 channel samples that align with 26 holes that were previously drilled. The channel samples are used in conjunction with the drillholes to model clean coal quality.

7.2 DRILLING

Historical exploration at the Leer Mine has relied exclusively upon continuous core drilling performed by competent contract drilling companies. Coreholes at the Leer Mine Property are typically 3.76-inch diameter (yielding 2.5-inch diameter core samples). Exploration drilling provides core samples of roof strata, the coal seam and floor strata. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any holes for poor core recovery, as all of the holes within the project area obtained core recovery of at least 90 percent. Arch's standard procedures state that holes with less than 95 percent core recovery are re-drilled in the same boring, using a wedge above the seam, so that offset drilling of a new hole is not required. During core drilling, all core samples are boxed, photographed, and stored. Roof and floor strata core samples are sent to laboratories for geotechnical strength tests. Coal seam core samples are sent to laboratories for quality analyses. Caliper, density, gamma, resistivity, and sonic downhole geophysical logs are completed as drill site and hole conditions allow. Each drillhole collar location is surveyed for accurate map coordinate and elevation data.

All original drillhole, survey, geological, geophysical, and quality data is scanned and stored on an Arch server, which is backed up nightly, so it can be accessed by select Arch personnel and quickly checked against the database, the geological model, or mine mappings. The original copies are stored in an offsite warehouse.

Table 7.2-1 summarizes the database of Arch's drilling programs.

Table 7.2-1 Drilling Programs

			Hole Type		Number of Holes with Base Data							
Drilling Series	Program Dates	Total Number of Drill Holes	Rotary	Core	Drill Hole Header	Survey Certificates	Geophysical Logs	Downhole Deviation Log	Geologist's Log	Driller's Log	Lab Analyis Certificates	Core Photographs
G Series	1922-1985	58	-	58	58	-	3	-	2	58	46	-
GN Series	2018	4	-	4	4	-	4	-	4	4	4	4
HT Series	2005-2015	90	-	90	90	32	3	-	90	85	86	89
HTR Series	2011-2012	6	1	5	6	-	5	-	-	5	-	-
LR Series	2015-2020	66	-	63	50	49	50	-	50	48	39	43
Ln Series	2020	7	-	7	7	-	-	-	7	-	-	-
M Series	1986-1993	2	2	-	2	-	-	-	-	2	-	-
T Series	1974-1982	50	-	50	50	-	29	-	50	50	50	-
WVGS	Unknown	1	-	1	1	-	-	-	1	-	-	-
Gaswells	Unknown-2014	13	NA	NA	13	6	7	-	-	-	-	-
		297	3	278	281	87	101		204	252	225	136

WEIR did not have direct involvement with the planning, implementation or supervision of Arch's drilling programs. However, having reviewed the details of each drilling program, WEIR finds the results to be consistent with industry standards and sufficient for use in the estimation of reserves and resources.

WEIR did not observe core samples in person, however, Arch provided photos of core logs for 136 drillholes. In review of these photos, WEIR found the cores to be representative of the data reported for each drillhole.

7.3 HYDROGEOLOGY

The Leer Mine is situated in the northern extent of the Tygart Valley River watershed within the Monongahela sub-basin, both being part of the greater Ohio Regional drainage basin. Drainages in the Leer Mine permit area include several named and unnamed, ephemeral and perennial tributaries. Three Fork Creek flows westward along the current Leer Mine permit boundary to its confluence with the Tygart Valley River at Grafton. To the south, Sandy Creek flows west along the Taylor-Barbour County border, draining into Tygart Lake to the southwest.

Principal aquifers within the Leer Mine permit area include the Buffalo and Mahoning sandstones at middle and lower elevations. These Pennsylvanian Age sandstones are typically confined by the less permeable Pittsburgh redbed strata capping the surrounding hilltops (see

Figure 6.3-2). The Tygart Valley River and regional groundwater flow direction is generally south to north, as water in the basin drains from the higher elevations in the Allegheny Mountain Province to the lower elevations of the Appalachian Plateau. Within the Leer Mine permit area, the gradient dips gently to northwest, with head elevation of 1,200 feet.

The average water infiltration rate into the Leer Mine void, based upon the expanded reserve area in Revision No. 21, ranges from 1,125 gallons per minute (gpm) to 1,515 gpm based upon two accepted procedures (McCoy and Leavitt equations) for estimating average infiltration. The average of the two infiltration rates, from both methods, would equate to 1,320 gpm. See Section 13.1.2 for further details on the hydrogeological model.

Arch has engaged in extensive surveying to characterize site hydrogeology and to determine groundwater inventories, water quality, and potential impacts to local usage as part of its Surface Mining Control and Reclamation Act (SMCRA) permitting process with the WVDEP. Baseline flow and quality parameters for surface and groundwater inventory have been established and monitored as required by WVDEP since 2005.

Water sampling methods for the Leer Mine are outlined and maintained by Arch in a site-specific work practice document. Reviewed annually, this operating procedure document details sampling locations, frequency, and collection protocols, including storage, transport, delivery and required chain of custody documentation. Approved methods for field data collection and instrument calibration are described, along with methods for creating sample splits, duplicates, and blind standards.

Samples are analyzed by independent laboratories that follow the most recent approved Environmental Protection Agency (EPA) sampling methodology and procedures. The laboratories employ internal quality control and quality assurance protocols before reporting results to Arch. Arch personnel then review the results again, as a second check for quality control and assurance before the results are published.

Groundwater inventories, water quality data, water balance, recharge and seepage rates have been reviewed in the approved permit and current permit revisions, including hydrologic impact assessments outlining risks, monitoring program detail, and mitigation obligations. Arch's approach to obtaining and managing its surface and groundwater data for the Leer Mine has been demonstrated to be adequate and aligned with regulatory requirements and standard industry practices. WEIR finds no material barriers to the continued success of the Leer Mine regarding hydrologic impact or compliance.

7.4 GEOTECHNICAL DATA

During core drilling, roof and floor strata of target coal seams are boxed, photographed and stored. Typically, three samples of roof and one sample of floor strata from each target seam are taken for strength testing where solid unbroken lengths of core exist. The samples are sent to the Appalachian Mining & Engineering laboratory in Lexington, Kentucky. Specific tests ran on core samples include Uniaxial Compressive Strength, Brazilian Indirect Tensile strength, Bulk Density, Specific Gravity, and Point Load index strength. Samples are prepared at the laboratory where the samples are machined into cylinders according to the appropriate ASTM specifications. Axial strain measurements are obtained using a hydraulic testing frame under a prescribed, constant load. Bulk density and specific gravity are determined by the weight, height, and diameter of the specimen used in the uniaxial strength test. Point load index strengths are obtained using a test frame with cones either perpendicular to, or parallel with, the specimen's bedding plane.

In addition to core strength testing, downhole sonic logging is performed on drillhole sidewalls to estimate compressive strength for rock strata. Sonic logs are generated using a high frequency sonic transducer that produces high-resolution imagery and reports strata characteristics such as fractures, compaction degree, and bedding plane orientation. The sonic logs are correlated with uniaxial strength measurements made on specimens from the same drillhole to estimate compression strength of roof strata. Sonic logging is a commonly used geophysical technique that provides valuable, low-cost data for ground control design.

A sample of the geotechnical data as used in a geotechnical study, *Longwall Chain Pillar Design for ICG's Tygart No. 1 Mine in the Lower Kittanning Seam* (WVU Pillar Study), commissioned with West Virginia University by Arch's predecessor company that controlled the Leer Property is shown in Table 7.4-1 as follows:

Table 7.4-1 Geotechnical Sample Data

Strata	Thickness (feet)	Youngs Modulus E (psi)	Poisson's Ratio v	Unconfined Compressive Strength (psi)	Tensile Strength (psi)	Friction Angle (degrees)
Borehole T212-82						
SH	14.20	1,240,337	0.09	1222	122	25.0
Drk Gry SH	7.14	1,240,337	0.09	1647	165	25.0
SH	9.32	1,240,337	0.09	1222	122	25.0
Drk Gry SH	13.39	1,240,337	0.09	1647	165	25.0
Gry SS	8.90	4,488,135	0.20	2364	236	30.0
Drk Gry SH	5.07	1,240,337	0.09	1647	165	25.0
LS	3.40	3,000,000	0.10	3107	311	42.0
SH	18.17	1,240,337	0.09	1222	122	25.0
SH w/ss Stks	9.74	3,142,738	0.21	2424	242	28.0
SH	2.50	1,240,337	0.09	1222	122	25.0
COAL (LK)	**6.00**	**300,000**	**0.34**	**900**	**90**	**30.0**
SH	4.62	1,240,337	0.09	1222	122	25.0
SH w/ss Stks	3.98	3,142,738	0.21	2424	242	28.0
Drk Gry SH	10.71	1,240,337	0.09	1647	165	25.0
Fireclay	9.36	250,000	0.30	547	55	20.0
SH w/ss Stks	4.00	3,142,738	0.21	2424	242	28.0
SH	13.88	1,240,337	0.09	1222	122	25.0

In addition to the WVU Pillar Study, Arch commissioned M. Heib (Heib Study) in February 2018 to conduct geotechnical testing and analysis of core holes in the Leer and Sentinel (now Leer South) mines. The report provides information related to horizontal stresses by roof strata, horizontal strain, Brinell Hardness, fracture trend analysis, Poisson's Ratio, uniaxial compressive strength, and Young's Modulus. A summary of the geotechnical data is shown in Table 7.4-2, as follows:

Table 7.4-2 Geotechnical Test Results

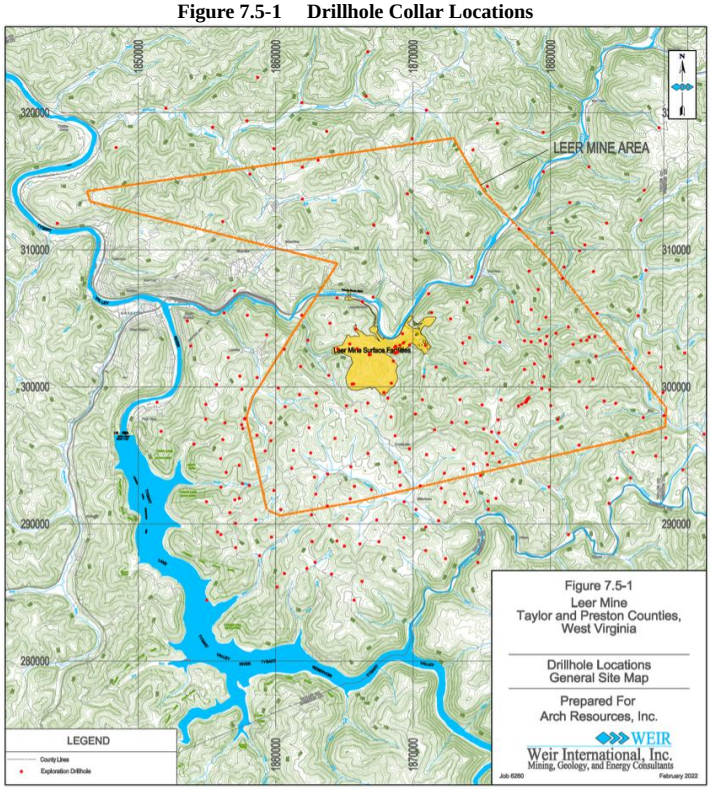
Hole	Sample	Included	Depth (feet)	Azimuth (degrees)	Principle Stress Major (psi)	Principle Stress Minor (psi)	Ratio	Lithology	Youngs Modulus E (psi)	Poisson's Ratio v	Unconfined Compressive Strength (psi)
HT101-13	UC-22	Yes	834.2	53	1,362	730	1.87	Shale	2.05E+06	0.17	3,714
HT101-13	UC-21	No	N/A	120	-	-	-	Sandy Shale	3.43E+06	0.01	6,755
HT101-13	UC-25	Yes	1008.3	83	2,873	1,712	1.68	Shale; fossils	5.56E+06	0.23	2,867
HT101-13	UC-32	No	N/A	53	-	-	-	Shale	6.32E+06	0.57	10,426
HT106-13	UC-30	Yes	422.7	118	815	413	1.97	Shale	2.49E+06	0.14	12,746
HT106-13	UC-37	Yes	436.6	73	1,555	806	1.93	Sandy Shale	2.96E+06	0.17	10,266
HT106-13	UC-34	Yes	498.6	107	1,330	693	1.92	Sandstone w/ shale streaks	2.64E+06	0.14	11,220
HT117-13	UC-24	Yes	359.8	35	385	155	2.48	Shale	5.55E+06	0.07	5,301
HT117-13	UC-23	No	N/A	32	-	-	-	Shale	6.48E+06	0.46	8,515
HT117-13	UC-36	Yes	422.7	70	2,719	1,618	1.68	Sandy Shale	8.18E+06	0.27	6,717
PD62-15	UC-29	No	N/A	155	-	-	-	Shale	3.35E+06	0.26	4,131
RM1602	UC-27	No	N/A	61	-	-	-	Shale	4.51E+06	0.24	7,924
RM1602	UC-26	No	N/A	65	-	-	-	Gray Sandstone	4.46E+07	0.03	10,388
			Average	79	1,577	875	1.93				

Since 2011, Arch has drilled 102 core holes in the Lower Kittanning Seam in the Leer Mine reserve area. All drillholes were cored, with core samples sent to Standard Labs for quality analyses. The thickness of the Lower Kittanning Seam identified in these drillholes ranged from 0.00 to 9.95 feet. A list of core holes drilled by Arch can be found in Table 7.6-1.

7.5 SITE MAP AND DRILLHOLE LOCATIONS

A map showing the location of all drillholes on the Leer Mine Property is shown on Figure 7.5-1.

Figure 7.5-1 Drillhole Collar Locations



7.6 DRILLING DATA

Arch generally uses Hammon Core Drilling, Inc. located in Craigsville, West Virginia to drill core holes. Downhole geophysical logging is performed by Geological Loggins Systems, located in Bluefield, Virginia. Coal quality analyses are currently performed by Standard Laboratories, Inc. (Standard Labs) located in Belington, West Virginia.

8.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

8.1 SAMPLE PREPARATION METHODS AND QUALITY CONTROL

Relative to the drilling conducted by Arch, once the target coal seam has been drilled, the coal core is pushed from the core barrel into a plastic lined wooden core box. The coal seam is measured and described by the geologist. The coal sample is then covered in plastic and the wooden box sealed. Cardboard dividers and foam tubing are used to tightly pack and cushion the coal sample within the wooden box. The coal core boxes are transported to the Arch core shed at Tucker Run where the core boxes are locked in a secure building. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. Within one week of completion of the core hole, the coal samples are removed from the wooden core boxes and placed in sealed plastic bags. The samples are coded and labeled with sample identification numbers based on drillhole id (for example, DT2001), sample sequence (A, B, C, etc..), and sample number, (1, 2, 3 etc..). (for example, DT2001A1 = first sample of first seam in drillhole DT2001.)

Once satisfied the data reports are accurate, the quality analyses are entered into the Arch coal database. Upon data entry completion, the modeling geologists export the data and inspects the data for variance from expected norms. If any data shows outside the norm for the property, the data is checked against laboratory results to ensure proper data entry. Quality data is gridded and mapped. Any anomalies in the data mapping are investigated. If anomalies are accurate, those items are brought to the attention of the mine engineers and sales staff.

8.2 LABORATORY SAMPLE PREPARATION, ASSAYING, AND ANALYTICAL PROCEDURES

8.2.1 Standard Laboratories, Inc.

Once quality samples are bagged and labeled, the samples are delivered to Standard Labs located in Belington, West Virginia for quality analyses. The samples are first prepared by crushing, splitting, and sizing. The analyses performed include Proximate, Washability, Ash Fusion, Ultimate, Ash Mineral, Dilatometer, Plastometer, Trace Elements, and Petrographics.

Standard Labs is certified via ANSI National Accreditation Board and located at 1196 Whitman Run Road, Belington, West Virginia 26250.

8.2.2 SGS North America, Inc

Standard Labs ships splits of the samples to the SGS North America, Inc. Mineral Services Division (SGS) laboratory located in Sophia, West Virginia for petrographic analyses. Petrographic analysis provides a clear understanding of the characteristics of the coal blend and is necessary to evaluate how coking operations will impact the final product.

SGS is certified via ISO/IEC 17025:2017 by A2LA and located at 151 Eastern Drive, Sophia, West Virginia 25921.

8.2.3 Eastern Associated Coal Corp. Laboratory

Approximately 19 core holes drilled in 1964, prior to Arch acquiring the property in 2011, were sent to Eastern Associated Coal Corp. Laboratory (EACC Lab) for analysis. WEIR was not provided any information of the protocols that the EACC Lab followed when performing the quality testing, but WEIR personnel familiar with the EACC Lab, when it was in operation, can confirm industry standard preparation sample and testing protocols were followed by the EACC Lab. Each laboratory quality sheet from EACC Lab was individually checked against a copy of the driller's and/or geologist's log to confirm that the samples match the depth and thickness of the coal seam. After completing a review of these quality samples, WEIR included these holes within the model.

8.3 QUALITY CONTROL PROCEDURES AND QUALITY ASSURANCE

Quality control procedures followed by Arch geologists are clearly defined. Arch's field geologists take specified steps to protect sample integrity and to ensure core samples are always under Arch geologist's control. These steps include the following:

- Field geologist to be on site whenever drilling is occurring
- Geologist's log to be created for each drillhole
- Rock-quality designation (RQD) logs to be prepared for roof and floor strata for all underground mineable seams
- Each drillhole to be logged using geophysical methods
- Underground mineable seams are sonic logged if drillhole conditions allow
- Geologist to compare field geologist's logs to the e-log data
- Geologist to compare the core samples against both field geologist's logs and e-logs to confirm coal thickness
- All immediate roof, coal and immediate floor core are to be boxed and photographed

- Quality sample sheets to be filled out, provided to a supervisor for approval and shipped to the laboratory
- Once core samples have been analyzed, field geologists to scrutinize the resulting quality data for accuracy
- Based on the homogeneity of the deposit and the consistent quality of the reserve area as evidenced from the product produced from this active mine, analytical laboratories are instructed to divide the samples and retain the second split for additional analysis should the original test report any anomalies.

8.4 SAMPLE PREPARATION, SECURITY, AND ANALYTICAL PROCEDURES ADEQUACY

Arch's procedures for quality analyses provide a full range of coal quality analyses so engineers and sales staff working with the data have a complete listing of the coal seam quality for each drillhole completed by Arch.

Drillhole core samples are assigned a sample ID number and a sample label is created. The label includes drillhole ID, sample ID number, and the to and from depths of the sample. The sample is then placed in a bag with the label. The bags are sealed using zip ties or tape. This is the beginning of the chain of custody. The samples do not leave the geologist's possession once removed from the core barrel. The samples remain with the geologist or are stored in a locked facility that only Arch geologists have access to, until delivery of the samples to the contracted laboratory. The delivery of the samples is carried out within one week of drillhole completion. Once in possession of the certified laboratory, the laboratory's security procedures are followed. After the sample has been tested, reviewed, and accepted, the disposal of the sample is done in accordance with local state and EPA approved methods.

WEIR has determined the sample preparation, security and analysis procedures used for the Leer Mine drillhole samples meet current coal industry standards and practices for quality testing and the laboratory results are suitable to use for geological modeling, mineral resource estimation and economic evaluation.

9.0 DATA VERIFICATION

9.1 DATA VERIFICATION PROCEDURES

Arch provided WEIR copies of all drilling records in the Leer Mine reserve area, which included Excel spreadsheets, driller's log, field geologist's logs, quality results sheets from the coal quality laboratories, mine measurement tables, as well as drawing files or PDFs of the e-logs. Each hole in the database was individually checked by WEIR against a copy of the driller's and/or geologist's log to confirm data accuracy.

Geological reviews performed by WEIR included:

- Drillhole lithology database comparison to geophysical logs
- Drillhole coal quality database comparison to quality certificates
- Channel sample coal quality database comparison to quality certificates

After completing the precursory verifications and validations described above, the drillhole data was loaded into Datamine's MineScape® Stratmodel, a geological modeling package. MineScape provides robust error checking features during the initial data load, which include confirmations of seam continuity, total depth versus hole header file data, interval overlap, and quality sample continuity with coal seams. Once the drillhole data was loaded, a stratigraphic model was created.

Several further verifications were then possible, which include:

- Creating cross sections through the model to visually inspect if anomalies occur due to miscorrelation of seams
- Creating structural and quality contour plots to visually check for other anomalies due to faulty seam elevations or quality data entry mistakes in the drillhole database

Typical errors which may impact reserve and resource estimation relate to discrepancies in original data entry. These errors may include:

- Incorrect drillhole coordinates (including elevation)
- Mislabeled drillhole lithology
- Unnoticed erroneous quality analyses where duplicate analyses were not requested
- Unrecorded drillhole core loss

WEIR conducted a detailed independent geological evaluation of data provided by Arch designed to identify and correct errors of the nature listed above. Where errors are identified and cannot be successfully resolved, it is WEIR's policy to exclude that data from the geological model. Based on its geological evaluation of data provided, WEIR did not exclude any holes within the Leer Mine resource areas.

9.2 DATA VERIFICATION LIMITATIONS

WEIR did not conduct an independent verification of property control surveys, nor has it independently surveyed the mining locations. Rather, WEIR has relied on information compiled from maps and summaries of the owned and leased property control prepared by Arch. WEIR did not conduct a legal title investigation relative to Arch's mineral and surface rights.

9.3 ADEQUACY OF DATA

It is WEIR's opinion that the adequacy of sample preparation, security, and analytical procedures for drillholes that were drilled by Arch after acquiring the property is acceptable and that these methods meet typical industry standards. Arch employs detailed process and procedures, described in Section 8.4, that are followed each time a core hole is to be sampled. The Arch geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. Arch coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0.

The adequacy of sample preparation, security, and analytical procedures are generally unknown for drillholes that were drilled prior to Arch acquiring the property in 2011. However, the geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. It is unknown if coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0, however, this legacy drillhole information was included as the samples matched the coal seam intervals and reported similar quality data. Model verifications further support WEIR's high level of confidence that a representative, valid, and accurate drillhole database and geological model has been generated for the Leer Mine that can be relied upon to accurately estimate coal resources and reserves.

The WVU Pillar Study described chain pillar designs for three and four entry gate road systems and provided minimum pillar sizes, which Arch exceeds, and should be an adequate basis for development of the Leer Mine LOM Plan. WEIR reviewed the WVU Pillar Study, which was authored by Dr. Syd S. Peng and A. Yassien, and found the quality of the work reasonable and WEIR is comfortable with the report results.

10.0 MINERAL PROCESSING AND METALLURGICAL TESTING

10.1 MINERAL PROCESSING TESTING AND ANALYTICAL PROCEDURES

Daily sampling is performed for plant feed and all stacking points prior to shipping clean coal products. The analyses performed include moisture, ash, sulfur, and Btu/lb on both an as-received and dry basis. These results help ensure both proper plant operation and coal product classification. Coal tonnages for raw and post-processed products, are estimated using standard belt scales which are calibrated monthly against the end of month survey data summary reports.

Efficiency testing is performed on all critical preparation plant circuitry on a bi-monthly basis to help ensure proper coal and non-coal separations are occurring throughout the plant operation. This performance testing is extensive and involves measuring flow rates, pressures, moistures, reagent application rates, size fractions, specific gravities, and coal qualities at specific processing points from raw feed all the way through products and tailings.

10.2 MINERALIZATION SAMPLE REPRESENTATION

Coal deposits originate in flat, low-lying ground within deltas, alluvial plains, and coastal systems, and as such are a relatively homogeneous, sedimentary mineral occurrence. The deposit within the Leer Mine area exhibits homogeneous characteristics and does not show any substantial variations in mineralization types or styles that would affect processing of the coal. Sample data are well representative of the deposit as a whole.

10.3 ANALYTICAL LABORATORIES

Coal sample analyses performed by Standard Labs are described in Section 8.2.1. Plant circuitry performance testing is performed by Precision Testing Laboratory, Inc. located in Beckley, West Virginia.

10.4 RELEVANT RESULTS AND PROCESSING FACTORS

Sample results by sample location for total moisture, as received ash, sulfur, Btu/lb, MAF Btu/lb, and dry ash, sulfur, Btu/lb, and volatile matter from January 2020 through March 2021 are summarized for count, minimum value, maximum value, average value and standard deviation in Table 10.4-1.

Table 10.4-1 Preparation Plant Sample Results

	Total Moisture (%)				
Sample Location	Count	Min	Max	Average	StdDev
Plant Feed	416	2.62	9.65	5.44	0.95
Coarse Met	518	3.21	20.73	7.14	2.94
#1 Midds	1,110	0.34	7.58	3.93	0.68
#2 Stacker-Met	316	5.54	9.75	7.28	0.66
#3 Stacker - Met	832	5.07	9.82	7.13	0.62

	As Received Ash (%)					Dry Ash (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	26.59	66.27	49.36	7.12	416	27.86	69.80	52.18	7.37
Coarse Met	518	4.84	9.71	6.55	0.64	518	5.46	10.14	7.05	0.59
Spiral Clean Product	268	4.69	13.86	7.87	1.47	268	4.70	13.93	7.92	1.48
#1 Midds	1,110	16.78	26.50	20.93	1.39	1,110	17.59	27.89	21.79	1.42
#2 Stacker-Met	316	5.39	7.04	6.32	0.31	316	5.89	7.62	6.82	0.33
#3 Stacker - Met	832	5.24	7.62	6.39	0.35	832	5.70	8.18	6.88	0.36

	As Received Sulfur (%)					Dry Sulfur (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	1.19	6.17	2.04	0.40	416	1.25	6.53	2.16	0.42
Coarse Met	518	0.70	1.40	0.99	0.11	518	0.75	1.47	1.06	0.11
Spiral Clean Product	268	0.86	1.53	1.16	0.11	268	0.87	1.54	1.16	0.11
#1 Midds	1,110	1.11	2.29	1.68	0.20	1,110	1.15	2.38	1.75	0.21
#2 Stacker-Met	316	0.73	1.14	0.96	0.07	316	0.79	1.23	1.04	0.08
#3 Stacker - Met	832	0.77	1.21	1.02	0.07	832	0.83	1.31	1.10	0.08

	As Received BTU/lb (%)					Dry BTU/lb.				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	2,929	10,318	6,289	1,261	416	3,092	10,809	6,661	1,357
#1 Midds	1,110	1,134	12,121	11,510	382	1,110	11,015	12,674	11,990	232
#2 Stacker-Met	316	13,144	13,765	13,506	102	316	14,406	14,853	14,568	63
#3 Stacker - Met	832	13,010	13,803	13,518	99	832	14,213	14,787	14,555	71

	MAF BTU/lb.					Dry Volatile Matter (%)				
Sample Location	Count	Min	Max	Average	StdDev	Count	Min	Max	Average	StdDev
Plant Feed	416	10,236	15,152	13,807	815	416	11.98	26.30	19.37	2.27
#1 Midds	1,110	15,167	15,459	15,329	37	1,110	25.94	29.93	27.83	0.73
#2 Stacker-Met	316	15,559	15,696	15,633	26	316	31.95	33.86	32.89	0.44
#3 Stacker - Met	832	15,305	15,698	15,629	32	832	31.24	34.19	33.00	0.54

Coal recovery and resulting product quality are primary concerns for any coal preparation plant. A coal preparation plant's recovery and resulting product quality are dependent on ROM coal quality and the efficiency at which raw ash may be removed by the preparation plant process. Tracking and adjusting throughput rates for different plant circuitry based on ROM coal feed quality is critical to plant efficiency and product quality.

Historical (2018 through 2021) preparation plant recovery averaged 46.6 percent and projected LOM Plan preparation plant recovery is estimated to range from 30.2 to 55.5 percent, averaging 40 percent over the LOM Plan.

While variable, preparation plant recovery is projected based on modeled out of seam dilution (OSD) based on well-defined seam structural grids. Projected preparation plant recovery reflects modeled changes in the ratio between mining height and coal seam height. Product qualities are expected to track closely with the modeled recovery from raw coal analysis, once adjusted for OSD material to be mined by the continuous miners and longwall.

Historical preparation plant performance from 2019 through 2021, based on 27.6 million preparation plant feed tons, processed 10.9 million metallurgical tons and 1.9 million middlings tons, with a resulting yield of 46.6 percent.

The actual results provide validation for modeled data and help to ensure coal sales specifications are met for resulting products.

10.5 DATA ADEQUACY

Arch employs testing and analytical procedures in accordance with industry standards, which result in efficient preparation plant operations and provides the necessary quality control to meet product quality and quantity projections. The testing performed is sufficient to support the projected preparation plant yield and saleable product quality for the LOM Plan.

11.0 MINERAL RESOURCE ESTIMATES

The coal resources, as of December 31, 2021, summarized below are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0 for reserve tonnage estimates). Resources are reported in categories of Measured, Indicated, and Inferred tonnage and in accordance with Regulation S-K Item 1302(d).

11.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

Data Sources

Planimetric data was provided by Arch in AutoCAD format and primarily included base map information such as rivers, drainages, roads, mine features, and property boundaries.

The drillhole data provided to WEIR by Arch included lithology, coal quality and survey data, and was provided in different formats including Excel, ASCII files and PDFs. Geophysical logs, coal quality certificates, driller's logs, geologist's logs, downhole deviation data, and drillhole survey records were provided as scanned PDF files and AutoCAD drawing files. Data was provided for 297 holes, all of which are included in the structural model.

In-mine seam thickness and floor measurement were provided in tabular file format. These mine measurements included 1,505 data points. In-mine coal thickness data points were generally measured every 100 to 300 feet in the mined-out areas. Mine measurement data points were used to model thickness and structure but were not used as points of observations in estimating resource confidence.

Coal quality data for 239 drillholes was provided for the Leer Mine. Of the 239 drillholes, 91 holes were used in the quality model. Data was provided in Excel format along with quality certificates in PDF. Reasons for excluding drillhole quality samples in the modeling process included:

- Poor core recovery noted in the driller's logs.
- Quality logs that could not be matched to a drillhole.
- The qualities listed for the hole were not relevant to the model (for example raw Btu/lb. or sulfur were supplied, but not final product Btu/lb. or sulfur). The only relevant raw values used are specific gravity and raw ash. Both are derivable from one another and have bearing on estimated in-place tons.

Geological Model

The Leer Mine geological model was constructed by using seam surface grids that were created in Datamine's MineScape® Stratmodel (MineScape) geological modeling package.

Topography data was gridded using MineScape software and a grid cell size of 50 feet by 50 feet. Topographic contours from the USGS were provided by Arch in CAD format in 20-foot intervals. The contours were provided in the NAD27, West Virginia North State Plane coordinate system (FIPS 4701). The gridded USGS topography contours were compared to drillhole collars and showed that there are differences between the two sets of elevation data. On average, the drillhole collars are less than five feet above or below the USGS topography grid, with the maximum difference of 98 feet. These differences are not uncommon when comparing a national data set to localized collar elevations. For this reason, WEIR has not excluded any of the holes that have a large difference.

The Lower Kittanning Seam does not outcrop within the Leer Mine permit boundary.

The seam surfaces and thicknesses were created by loading the drilling and mine measurement data into MineScape and gridding the seam intercepts using a grid cell size of 50 feet by 50 feet. The parameters used to create the model are defined in the MineScape modeling schema which is a specification of modeling rules that is created for the site. The MineScape interpolators that were used in this study are common in most mine planning software packages. The Planar interpolator is a triangulation method with extrapolation enabled. Finite Element Analysis (FEM) is a widely used method for numerically solving differential equations arising in engineering and mathematical modeling. A trend surface is used in MineScape to promote conformability for the modeled seams to regional structures such as synclines, anticlines, or simply seam dip. MineScape caters to using different interpolators for thickness, roofs and floors (surfaces), and the selected trend surface as they are all modeled separately. The interpolator used for each of these items is selected on the basis of appropriateness to the data sets involved, as well as modeling experience. Stratigraphic Model Interpolators are shown in Table 11.1-1 as follows:

Table 11.1-1 Stratigraphic Model Interpolators

Interpolator	Parameter	Power/Order
Planar	Thickness	0
FEM	Surface	1
Planar	Trend	0

The coal seam that was modeled for this TRS is the Lower Kittanning Seam. Arch controls several other seams above and below the Lower Kittanning Seam that were loaded into the geological model, however, resources were not estimated for these additional seams. A summary of drilling statistics for the Lower Kittanning Seam is shown in Table 11.1-2.

Table 11.1-2 Drillhole Statistics

			Average	Minimum		Maximum		Standard
	In Mine	Number of	Thickness	Hole	Thickness	Hole	Thickness	Deviation
Seam	Plan	Intercepts	(Feet)	Name	(Feet)	Name	(Feet)	(Feet)
Lower Kittanning	Yes	1,779	5.61	LR1907	0.00	MML1814	10.50	1.16

The gridded structure surfaces and coal seam thicknesses were validated against drillhole information to ensure that the data was properly modeled. Inconsistencies between modeled seam surfaces and surrounding drillholes were investigated and any confirmed errors in the drillhole data or model parameters were corrected. This process was repeated until a final version of the model was developed.

Coal Quality Model

The drillhole and channel sample quality data described previously in this report were used to create a washed coal quality model that included raw ash and raw relative density. The washed quality model values were based on a specific gravity of 1.50.

The drillholes were verified to ensure that the seam depths used in the lithology file matched the sample depths in the quality file. Twenty-five holes were found to have a fully sampled interval that included the Lower Kittanning Rider Seam, parting, and the Lower Kittanning Seam. In each of these 25 holes, the samples were composited and added to the quality model since the combined thickness of the three plies was less than the maximum mining height.

Coal quality samples were loaded into MineScape and composited against the drillhole thicknesses. The composited values were then gridded using a grid cell size of 200 feet by 200 feet and the inverse distance weighted (squared) interpolator. The following quality data was modeled for the Lower Kittanning Seam:

- Raw
  - Ø Ash, Dry, weight percent
  - Ø Relative Density
- Float @ 1.50 Specific Gravity
  - Ø Ash, Dry, weight percent

- Calorific Value, Dry, Btu/lb
- Total Sulfur, Dry, weight percent
- Volatile Matter, Dry, weight percent
- Audibert-Arnu Maximum Dilation (ARNU), Dry, percent
- Vitrinite, Dry, weight percent
- Total Inerts, Dry, weight percent
- Rank Index
- Composition Balance Index
- Gieseler Maximum Fluidity, Dry, DDPM
- Hargrove Grindability Index, Dry
- Reflectance (ROMAX), Dry, percent
- Calculated Stability Index
- Free Swell Index
- Yield, weight percent

Quality contours were generated from the grids to check outlier values.

Additional Resource Criteria and Parameters

Based on WEIR's review and evaluation of the data and plans relative to the Leer Mine, resource estimation criteria were applied to ensure reported mineral resource tonnage has a reasonable prospect for economic extraction. Resource criteria and parameters for the Leer Mine are as follows:

- Resources were estimated as of December 31, 2021.
- Coal density is based on specific gravity data from drillholes and channel samples.
- Areas where coal thickness did not meet a minimum thickness of 3.0 feet were excluded from the resource estimate.
- Areas within 200 feet of old mine workings were excluded from resource estimates.
- Areas with less than 200 feet of cover were excluded from resource estimates.
- Tonnages associated with uncontrolled areas within the exclusive resource areas are excluded in resource estimates.
- Areas not considered feasibly accessible because of geometry and location in relation to previous mine workings were excluded from resource estimates.
- Areas that are currently covered by refuse, or planned refuse, were excluded from the resource estimate.

- Tonnage outside of current LOM Plan, but within existing property control, and meeting the criteria listed here, was classified as Resource tonnage and is reported exclusive of Reserve tonnage.

11.2 ESTIMATES OF MINERAL RESOURCES

The coal resources, as of December 31, 2021, are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0). Resources are reported based on the coal resource estimate methodology described and are summarized in Table 11.2-1 as follows:

Table 11.2-1 In-Place Coal Resource Tonnage and Quality Estimate as of December 31, 2021

			Average Coal	In-Place Resources (000 Tons)				Coal Quality (Dry Basis) Raw	
Mine Area	Seam	Area (Acres)	Thickness (Feet)	Measured	Indicated	Total	Inferred	Ash (%)	Relative Density (Lbs/CF)
Leer LOM	Lower Kittanning	2,195	4.39	2,400	11,600	14,000	4,900	20.8	90.48

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable underground mine assuming a 3.0 feet minimum seam thickness, a high vol A coal realizing a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton.
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding

11.3 TECHNICAL AND ECONOMIC FACTORS FOR DETERMINING PROSPECTS OF ECONOMIC EXTRACTION

A Preliminary Feasibility Study was conducted to assess the prospects for economic extraction of coal within the Leer Mine.

The Free on Board (FOB) Mine coal sales price used in assessing the economic mineability of the Leer Mine is primarily based on sales of high volatile A metallurgical coal product, which averaged $118.91 per ton in 2018 through October 2021 and is projected to average $119.00 per ton over the Leer Mine LOM Plan. In addition to the metallurgical coal product, the Leer Mine sells a high ash middlings coal product, which averaged $26.36 per ton in 2018 through October 2021 and is projected to average $27.16 per ton over the Leer Mine LOM Plan. The

overall coal sales price is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine coal sales price is $110.18 per ton. The sales price is further supported in Section 16.0 of this report.

Capital expenditures are discussed in further detail in Section 18.1 and are projected to average $6.99 per ton over the Leer Mine LOM Plan compared to actual capital expenditures of $4.55 per ton in 2018 through 2020.

Operating costs are discussed in further detail in Section 18.2 and are projected to average $72.49 per ton over the Leer Mine LOM Plan compared to actual Leer Mine operating cost that averaged $61.98 per ton from 2018 through 2020.

Total projected capital expenditures and operating cost of $79.48 per ton and the coal sales price of $110.18 per ton, provide a reasonable basis for WEIR to determine that all coal of thickness greater than 3.0 feet has prospects of economic extraction within the Leer Mine.

WEIR estimated a breakeven NPV would result from a LOM Plan with an average coal thickness of 3.09 feet. Therefore, a coal thickness minimum cutoff of 3.0 feet would ensure that the Leer Mine LOM Plan average coal thickness would be greater than 3.0 feet, resulting in likely prospects for economic extraction. Relatively small areas within the LOM Plan have coal that may be thinner than the 3.0 feet cutoff and are evaluated on a case-by-case basis to determine if they are deemed to have prospects of economic extraction based on the economic benefit from mining these less than 3.0 feet areas to access and recover areas with higher coal thickness.

11.4 MINERAL RESOURCE CLASSIFICATION

Mineral Resource estimates prepared for the Leer Mine are based on the Regulation S-K Item 1302(d), which established definitions and guidance for mineral resources, mineral reserves, and mining studies used in the United States. The definition standards relative to resources are as follows:

Mineral Resource:
Mineral resource is a concentration or occurrence of material of economic interest in or on the Earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for

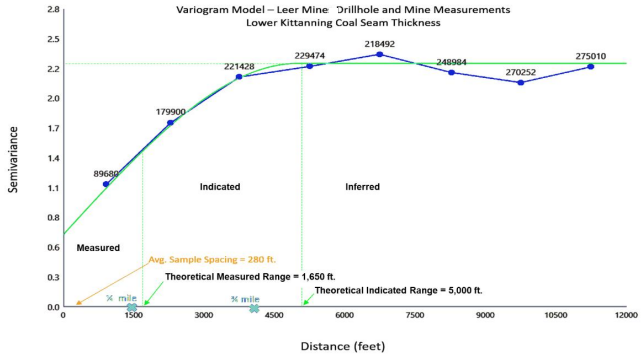
economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.

- *Inferred mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Because an inferred mineral resource has the lowest level of geological confidence of all mineral resources, which prevents the application of the modifying factors in a manner useful for evaluation of economic viability, an inferred mineral resource may not be considered when assessing the economic viability of a mining project, and may not be converted to a mineral reserve.
- *Indicated mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Because an indicated mineral resource has a lower level of confidence than the level of confidence of a measured mineral resource, an indicated mineral resource may only be converted to a probable mineral reserve.
- *Measured mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The level of geological certainty associated with a measured mineral resource is sufficient to allow a Qualified Person to apply modifying factors, as defined in this section, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit. Because a measured mineral resource has a higher level of confidence than the level of confidence of either an indicated mineral resource or an inferred mineral resource, a measured mineral resource may be converted to a proven mineral reserve or to a probable mineral reserve.

Geostatistical methods were applied to drillhole and mine measurement coal thickness data for the Lower Kittanning Seam at the Leer Mine to develop variogram ranges (radii) used for

resource classification. Figure 11.4-1 illustrates the variogram using 1,779 seam thickness measurements, both within and outside of the LOM Plan.

Figure 11.4-1 Variogram Model - Lower Kittanning Seam Thickness



As depicted above, variability in drillhole thickness measurements is highly correlated with the distance between individual drillholes, in particular within the theoretical ranges for Measured and Indicated tonnage. Additionally, WEIR's generation and review of the applicable quality contours further supports the continuity of coal quality throughout the deposit. Table 11.4-1 shows Lower Kittanning Seam quality parameters for the composited quality samples.

The theoretical ranges estimated for Measured (to 1,650 feet) and Indicated (to 5,000 feet) resources in WEIR's variographic and quality analysis demonstrates the spatial continuity of mineable coal seam thickness and quality in the Lower Kittanning Seam at the Leer Mine. WEIR has a high level of geological confidence in this data and considers it sufficient to allow for the application of modifying factors to support detailed mine planning and evaluation of the economic viability of the deposit within the Measured and Indicated ranges.

Table 11.4-1 Lower Kittanning Seam Quality Parameters for Composited Samples

Quality	Number	Total Length	Minimum	Maximum	Average
Audibert-Arnu Maximum Dilation %	72	469.41	203	322	300
Composition Balance Index	72	469.41	0.5	1.2	0.8
Calculated Stability	72	469.41	44	57	53.4
Free Swell Index	71	466.21	7.7	9	8.3
Rank Index	72	469.41	3.61	4.15	3.94
Reflectance % (ROMAX)	72	469.41	0.99	1.08	1.03
Vitrinites	72	469.41	55.8	75.7	66.19
Ash %	92	588.13	5.19	12.9	8.53
Btu	74	482.53	13,646	15,137	14,263
Sul %	92	588.13	0.54	2.53	1.21
Volatiles %	73	477.11	29.09	35.43	31.85

Note: All qualities at 1.50 Float Specific Gravity

The table above includes coal that is to be processed into both the middlings product and the metallurgical product and as such is a predictive measure but does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR has chosen to apply classification radii more conservative than the theoretical radii demonstrated above to be consistent with previous reporting for the Leer Mine deposit. Selection of more conservative classification radii only further increases confidence within the various tonnage classification categories.

Classification radii utilized by WEIR in this study are as follows:

- Measured: 0 - 1,320 feet (based on 1,730 observations informing estimate of coal thickness within this range)
- Indicated: 1,320 - 3,960 feet (based on 1,769 observations informing estimate of coal thickness within this range)
- Inferred: greater than 3,960 feet (based on 1,769 observations informing estimate of coal thickness within this range)

11.5 UNCERTAINTY IN ESTIMATES OF MINERAL RESOURCES

Mining is a high risk, capital-intensive venture and each mineral deposit is unique in its geographic, social, economic, political, environmental, and geologic aspects. At the base of any mining project is the mineral resource itself. Potential risk factors and uncertainties in the geologic data serving as the basis for deposit volume and quality estimations are significant considerations when assessing the potential success of a mining project.

Geological confidence may be considered in the framework of both the natural variability of the mineral occurrence and the uncertainty in the estimation process and data behind it. The mode of mineralization, mineral assemblage, geologic structure, and homogeneity naturally vary for each deposit. Structured variability like cyclic depositional patterns in sedimentary rock can be delineated mathematically with solutions like trend surface analysis or variography. Unstructured variability, in the distribution of igneous rock composition, for example, is more random and less predictable.

The reliability of mineral resource estimation is related to uncertainties introduced at different phases of exploration. Resources meeting criteria for Measured, Indicated, and Inferred categories are determined by the quality of modeled input data, both raw and interpreted. An exploration program comprises several stages of progressive data collection, analysis, and estimation, including:

- Geological data collection
- Geotechnical data collection
- Sampling and assaying procedures
- Bulk density determination
- Geological interpretation and modeling
- Volume and quality estimation
- Validation
- Resource classification and estimation

Error may be introduced at any phase. Data acquisition and methodologies should be properly documented and subject to regular quality control and assurance protocols at all stages, from field acquisition through resource estimation. Managing uncertainty requires frequent review of process standards, conformance, correctional action, and continuous improvement planning. Risk can be minimized with consistent exploration practices that provide transparent,

backwards traceable results that ultimately deliver admissible resource estimates for tonnage and quality.

Less dense drillhole coverage in the northwestern portion of the northern extension of the Leer Mine is a source of uncertainty, however that uncertainty is reflected in the classification of Indicated and Inferred resources versus Measured resources.

As discussed in Sections 8.0, 9.0, and 10.0, it is WEIR's opinion that Arch's methodologies of data acquisition, record-keeping, and QA/QC protocols are adequate and reasonable for resource estimation at the Leer Mine.

In summary, WEIR has reviewed all geologic and geotechnical data inputs, collection protocols, sampling, assaying, and laboratory procedures serving as the basis for the deposit model, its interpretation, and the estimation and validation of the volume and quality of coal resources at the Leer Mine. The spatial continuity of the Lower Kittanning Seam coal deposit at the Leer Mine is well demonstrated by professionally developed, well maintained, quantitative and qualitative data. WEIR finds no material reason regarding geologic uncertainty that prohibit acceptably accurate estimation of mineral resources.

11.6 ADDITIONAL COMMODITIES OR MINERAL EQUIVALENT

There are no other commodities or minerals of interest within the Leer Mine resource area other than the coal deposit discussed in this TRS.

11.7 RISK AND MODIFYING FACTORS

Sporadic, significant thicknesses of fireclay floors have been present in some of the previously mined areas, but did not adversely affect mining operations. There are similar such sporadic areas in future planned panels, which based on prior experience, are also not expected to adversely affect mining operations. Mine management recognizes that it is important to keep water out of these areas so that normal operations are not negatively affected.

Within the Leer Mine LOM Plan area, there are approximately 270 acres of uncontrolled property. Of that total, approximately 10 acres are within the exclusive resource area. Failure to obtain mining rights on the uncontrolled exclusive resource areas will have no impact on

the projected LOM Plan. The approximately 270 remaining uncontrolled acres are within the LOM Plan and are discussed in Section 12.6.

The concentration of drilling within the exclusive resource area is less dense than the rest of the Leer Mine area. This wider spacing can decrease the confidence of structural features, including seam thickness, roof and floor elevations, and definition of the 200-feet cover line. The resource area in the northern extension of the Leer Mine is bounded by the 200-feet cover line in some areas, with the spacing of the drilling near this line between 3,000 and 6,000 feet. Arch generally uses a 100-feet cover line as a cut-off for tonnage estimates within Central and Northern Appalachia, and generally do not longwall mine with less than 200-feet of cover but there are limited exceptions in the LOM Plan. This is evaluated on a case-by-case basis. Because of this WEIR has decided to use the more conservative 200-feet cover line. This affects only areas that are adjacent to Lower Kittanning Seam outcrops. However, these outcrop areas are exclusively outside of areas that WEIR considered for coal resource classification, and as such do not involve material uncertainty. Additional drilling in the northern extension of the Leer Mine will increase confidence in the structural features and better define the resource boundary.

Risk is also associated with volatility of coal market prices. However, even significant variations in operating costs, capital expenditures, and productivity would not likely preclude the economic mineability of the Leer Mine, at projected metallurgical coal market prices.

Unforeseen changes in legislation and new industry developments could alter the performance of Arch by impacting coal consumer demand, regulation and taxes, including those aimed at reducing emissions of elements such as mercury, sulfur dioxides, nitrogen oxides, particulate matter or greenhouse gases. The emphasis on reducing emissions, however, is more of a concern for mines producing a thermal coal product, as opposed to the core metallurgical coal produced from the Leer Mine.

12.0 MINERAL RESERVE ESTIMATES

12.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

The conversion of resources to reserves at the Leer Mine considers the effects of projected dilution and loss of product coal quality, projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine layout that accommodates the planned mining equipment and provides a safe underground work environment is also considered.

It is important to note that the LOM Plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

The Leer Mine LOM Plan layout has several key variables that will largely impact coal recovery. Pillar and panel dimensions are based on minimum, maximum, and optimal equipment operating parameters, as well as geotechnical considerations for mine operations safety and subsidence predictions.

Based on the mine's historical performance and projected mineral continuity, the mine design is the primary consideration, apart from mineral resource classification, whereupon resources are converted to reserves at the Leer Mine.

Based on WEIR's review and evaluation of the Leer Mine LOM Plan, the justification for conversion of resources to reserves were based on specific criteria. The following criteria were used to estimate reserves for the Leer Mine Property:

- Reserves were estimated as of December 31, 2021.
- Coal density was based on specific gravity data from drillholes and channel samples.
- Minimum mining height of 8.00 feet (96 inches) for continuous miners and 6.50 feet (78 inches) for the longwall.

- Maximum mining height of 8.0 feet (96 inches) for the longwall. Continuous miner areas can mine total thickness of the Lower Kittanning Seam anywhere in the Leer Mine Property.
- A minimum of six inches of out of seam dilution (three inches floor and three inches roof) is included in the ROM tonnage estimates, except in areas where the total seam thickness is greater than the maximum mining height. Mine measurements support the estimated dilution thickness.
- The different mining methods at the Leer Mine result in different aerial recoveries. Since seam heights are almost exclusively less than maximum longwall mining equipment mining heights, a recovery of 100 percent is applied for the longwall operations, as is typical in the industry. The continuous miner works' recoveries involve a smaller percentage of the total mined coal, and has variable recovery that is calculated based on development type (i.e. gateroads, main entries, supersections). The resulting recoveries for the continuous miners are based on design pillar sizes and ranges from approximately 30 to 66 percent. Mining recovery based on measured coal recovery by type of mining, are applied as follows:
  - Ø Longwall 100 percent
  - Ø Continuous Miner 42 percent
- For mine design purposes, it is assumed that acquisition of mineral control for currently uncontrolled areas will be successful, as it has been historically. LOM Plan design includes these uncontrolled areas, and acquisition cost as well as revenue from the sale of uncontrolled tonnage associated with these areas is included in the Preliminary Feasibility Study.
- Arch's mineral rights over the Leer Mine coal deposits supersedes the mineral rights for oil and gas wells on the property. Arch maintains the right to have the wells plugged and mine through them. Arch is required to compensate the well owner when the revenue stream from a well ceases. Typical acquisition cost of a well is $75,000 to $100,000, while plugging a gas well to Mine Safety and Health Administration (MSHA) standards, in order to mine through a well, ranges from $200,000 to $300,000 (included in capital costs). Therefore, coal tonnage surrounding the oil and gas wells has been included in the reserve estimates.
- The point of reference of reserve estimates is post preparation plant processing and recoverable tons were adjusted for a theoretical preparation plant yield based on drillhole and channel sample analyses washed at a 1.50 specific gravity.

- A conservative preparation plant efficiency factor of 95.0 percent was applied to reflect actual performance of the preparation plant, compared to theoretical laboratory results at a 1.50 specific gravity.
- The estimate of Reserve tons includes areas that are exclusively within the current Leer Mine LOM Plan.

12.2 ESTIMATES OF MINERAL RESERVES

The coal reserves that represent the economically viable tonnage controlled and uncontrolled by Arch, based on the coal reserve estimate methodology described and independent evaluation of the geology, are shown in Table 12.1-3 as follows:

Table 12.1-3 Recoverable Coal Reserve Tonnage and Quality Estimate as of December 31, 2021

								Coal Quality (Dry Basis)	
								Raw	
Mine Area	Seam	Product Quality	Area (Acres)	Average Coal Thickness (Feet)	Clean Recoverable Tons (000) Reserves Proven	Probable	Total	Ash (%)	Relative Density (Lbs/CF)
Controlled									
Leer LOM	Lower Kittanning	High Vol A	8,910	5.23	18,050	26,300	44,350	19.30	89.91
Uncontrolled									
Leer LOM	Lower Kittanning	High Vol A	270	5.33	590	810	1,400	20.39	90.01
Total			9,180	5.23	18,640	27,110	45,750	19.31	89.91

Notes:

- Clean recoverable Reserve tonnage based on mining recovery of 42 percent for continuous miner mining, 100 percent for longwall mining, modeled preparation plant yield, and a 95 percent preparation plant efficiency
- Mineral Reserves estimated at a sales price of $110.18 per ton FOB Mine and operating cost of $72.49 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources.
- Coal quality listed includes coal that is to be processed into both the middlings product and the metallurgical product and does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

WEIR depleted LOM Plan reserve tonnage using actual mine workings through September 30, 2021, and subtracted actual production, reported by Arch, for the remainder of the year to arrive at reserves as of December 31, 2021.

WEIR completed a validation check of its model by using the model to calculate the theoretical tonnage of the areas mined in 2021 and comparing the results to the actual production tonnage in 2021. The results were within a variance of 2.3 percent. The variance can be explained in part by the differing methods of calculating tons. The WEIR model used a constant 42 percent mining recovery for all continuous miner development, whereas Arch's mining recovery ranged from 30 to 66 percent, based on whether mining gateroads or mains. The results of the validation are shown in Table 12.1-4.

Table 12.1-4 Reserve Validation

Mine Area	Seam	Actual 2021 Production Tons	Estimated Model Tons	Variance (%)
Leer	Lower Kittanning	4,370,000	4,270,000	1.02

12.3 ESTIMATES OF RESERVE CUT-OFF GRADE

WEIR estimated an average coal thickness of 3.09 feet would result in a breakeven NPV. Therefore, a coal thickness cutoff of 3.0 feet would ensure that the Leer Mine LOM Plan average coal thickness would be greater than 3.0 feet and result in positive NPV.

Based on WEIR's review and evaluation of the Leer Mine LOM Plan, mining coal less than 3.0 feet in thickness is minimal and only conducted on a case-by-case basis. Approximately 40 acres of coal with less than 3.0 feet thickness has been included in the reserve estimate.

Based on historical product coal quality, current coal sales contracts, and projected coal quality modeled by WEIR, WEIR does not foresee future coal quality deviations from the present that would adversely affect the saleable coal product.

12.4 MINERAL RESERVE CLASSIFICATION

WEIR prepared the Leer Mine reserve estimates in accordance with Regulation S-K Item 1302(e), which establishes guidance and definitions for mineral reserves to be used in the United States. The SEC Regulation S-K Definition Standards relative to reserves are as follows:

Modifying factors are the factors that a qualified person must apply to indicated and measured mineral resources and then evaluate to establish the economic viability of mineral reserves. A qualified person must apply and evaluate modifying factors to convert measured and indicated mineral resources to proven and probable mineral reserves. These factors include but are not restricted to: Mining; processing; metallurgical; infrastructure; economic; marketing; legal; environmental compliance; plans, negotiations, or agreements with local individuals or groups; and governmental factors. The number, type and specific characteristics of the modifying factors applied will necessarily be a function of and depend upon the mineral, mine, property, or project.

A *mineral reserve* is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the qualified person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.

- *Probable mineral* reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource.
- *Proven mineral reserve* is the economically mineable part of a measured mineral resource and can only result from conversion of a measured mineral resource.

Within the extent of the LOM Plan for the Leer Mine, Measured Resources were converted to Proven Reserves and Indicated Resources were converted to Probable Reserves. Within the extent of the LOM Plan for the northern extension of the Leer Mine, Measured and Indicated Resources were converted to Probable reserves.

12.5 COAL RESERVE QUALITY AND SALES PRICE

Leer Mine coal quality was determined by modeling the drillhole coal quality analyses for the reserve areas. The average dry basis coal quality, for raw coal and washed coal at a 1.50 specific gravity, for the reserves is shown in Table 12.5-1 as follows:

Table 12.5-1 Average Reserve Quality

	Coal Quality (Dry Basis)																	
	Raw		Washed @ 1.50 Specific Gravity [2]															
Seam	Ash (%)	Relative Density (Lbs/Cu.Ft.)	Ash (%)	Sulfur (%)	Volatile Matter	Calorific Value (Btu/lb.)	Theoretical Plant Yield (%)	Audibert-Arnu Maximum Dilation (%)	Composition Balance Index	Calculated Stability Index	Fluidity DDPM	Free Swell Index	Hardgrove Grindability Index	Total Inerts (%)	Reflectance [1] Rank Index	ROMAX (%)	Vitrinites (%)	
Lower Kittanning	19.30	89.86	8.38	1.19	31.90	14,281	71.10	170 - 332	0.86	53.90	30,000	8.50	74.00	25.12	3.96	0.96 - 1.08	65.30	

[1] Minimum/Maximum

The table above includes coal that is to be processed into both the middlings product and the metallurgical product and as such is a predictive measure but does not represent actual shipped products, which can vary for many reasons, including variations in coal depositional characteristics, non-coal parting and OSD quality characteristics and preparation plant separation specific gravities. As part of the preparation plant processing, the poorer quality middlings product is removed from the remaining clean coal, resulting in a higher quality metallurgical product.

Even though the middlings product will be separated from the metallurgical product, the average quality (inclusive of the middlings product) for the reserve tons show that the Leer Mine is a high volatile metallurgical coal product, with good coking properties. The range of dry washed volatile matter is between approximately 30 and 33 percent, with an average of 31.9 percent. The average quality is low ash, low sulfur, very low moisture, and high fluidity, all of which indicate good coking coal qualities.

The projected coal sales price in the Preliminary Feasibility Study is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine coal sales price is $110.18 per ton. As detailed previously, average sales price of high volatile A metallurgical coal product from 2018 to October 2021 was $118.91 per ton. The coal sales price is further supported in Section 16.0 of this TRS.

12.6 RISK AND MODIFYING FACTORS

The estimate of reserve tons includes areas that are exclusively within the Leer Mine LOM Plan. The concentration of valid drilling data points within the Leer Mine are generally less than 500 feet from the next nearest data point, resulting in a high confidence. All reserves within the Leer Mine LOM Plan area are within the Proven and Probable classifications determined using the geostatistics variographic study discussed in Section 12.4-1. While the concentration of drillholes in the proposed northern extension of the Leer Mine are not as dense as the active Leer Mine, the majority of reserve tons are within the Probable classification. It is WEIR's recommendation to add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the reserve area and potentially reclassify the Inferred Resource tons to a Probable Reserve.

Due to the relatively simple geology in the area, and the relatively high continuity of the Lower Kittanning Seam within the Leer Mine LOM Plan (both structure and quality), geologic uncertainties do not appear to pose a significant risk to the project. However, as mentioned in Section 11.7, relatively thick intervals of fire clay in the floor of some areas will require planning to avoid soft floor conditions which could potentially, in turn, cause adverse mining conditions. Keeping a dry mine in these areas will be important and should prove to be effective to avoid adverse floor conditions that could potentially hinder mine operations otherwise.

The Leer Mine has an excellent safety record and maintains diligent regulatory compliance. Workforce census has been, and is expected to remain stable. The primary mining equipment is well-maintained and has sufficient capacities to attain projected levels of productivity and production. This further contributes to Leer Mine being a relatively low risk operation.

Property acquisition problems in the future could affect some of the longwall panels. Even though the remaining reserves within the uncontrolled property are relatively small (approximately 270 acres total), moving the longwall system around uncontrolled property would likely result in significant production down time. In some cases, portions of the lost longwall panel adjacent to the uncontrolled property can be recovered utilizing continuous miners. WEIR is not aware of any obstacles to obtaining necessary property rights, and reasonably believes that the chances of obtaining such rights in a timely manner are highly likely. Given prior successes in Arch's property acquisition efforts, and relatively small tonnage impacts for unsuccessful reserve property acquisitions, this risk appears relatively low, as well.

Approximately 1.4 million tons of uncontrolled reserves were included within the reserve estimate. These estimated tons are within the uncontrolled properties that exist within the Leer Mine LOM Plan. Acquisition of these relatively small blocks of mineral resource is on-going by Arch and not dissimilar to other mining companies' property control tasks involving relatively small areas. The cost of acquiring these uncontrolled tracts is included within the economic model.

Coal recovery is an important aspect in assessing the economic viability of a mine. Based on Arch's historical extraction rates and generally conservative pillar design, WEIR does not anticipate significant deviation of product recovery in the future. Continuous miner recovery of 50 percent, without second mining, is a general industry mining recovery. However, given that the Leer Mine continuous miners are mostly developing gate roads with more conservative pillar sizing for support of longwall panels, the LOM Plan continuous miner recovery is

expected to range from approximately 30 to 66 percent, and average 42 percent. The recovery is based on the pillar size that has been designed for the particular work the continuous miners are completing. As noted above, the pillars' design is most importantly intended to provide safe operation of the primary coal extraction efforts which involve the longwall machinery. WEIR utilized a weighted average mining recovery of 42 percent for the Leer Mine continuous miners in its estimation of recoverable reserves, based on the pillar size required for the type of continuous miner development. The 100 percent longwall panel recovery is also a typical industry longwall mining recovery (when excluding head and tailgates and bleeders). As previously stated, reported reserves are not inclusive of any coal beyond the mining height limitations of the current equipment, which excludes approximately 58,000 clean recoverable tons over the Leer Mine LOM Plan.

Risk is also associated with the volatility of coal market prices. Even significant variations in operating costs, capital expenditures, and productivity would not likely preclude the economic mineability of the Leer Mine, at projected metallurgical coal sales prices.

13.0 MINING METHODS

The mining method utilized by the Leer Mine is longwall mining, with room and pillar continuous mining to develop main entries, longwall headgates and tailgates, and retreat mining production panels. The longwall mining method has been successfully utilized in the NAPP Region, and in other coal producing regions of the United States, since the 1960s. Longwall mining has the highest mining recovery of modern-day underground mining methods.

The Leer Mine is mining the Lower Kittanning Seam and parting interval within the seam utilizing continuous miners to develop longwall panels to be mined using a longwall mining system. The Leer Mine develops longwall districts (sets of adjacent longwall panels) with alphabetic designations. As of September 2021, the Leer Mine had completed mining in 18 longwall panels and was mining the 19th longwall panel (1 Left) in the 6th longwall district (see Figure 13.5-1).

13.1 GEOTECHNICAL AND HYDROLOGICAL MODELS

13.1.1 Geotechnical Model

ICG, Arch's predecessor, commissioned Mr. Syd S. Peng and Mr. Asmaa Yassien, of West Virginia University, Department of Mining Engineering to conduct a geotechnical study, WVU Pillar Study, dated December 2010. The Tygart No. 1 Mine was later renamed the Leer Mine by Arch. The study described chain pillar designs for three and four entry gateroad systems, using the Analysis of Longwall Pillar Study (ALPS) and computer numerical methods, and concluded, based on the geotechnical information from Section 7.4, that four entry gateroads with square pillars on 80 feet centers would be stable during different stages of mining and square pillars with 90 feet centers recommended when developing three entry gateroads. The current Leer Mine gateroad pillars exceed the pillar dimensions in the study, with gateroad pillars on 90 x 140 feet centers for the four entry gateroads and pillars 102 feet x 140 feet centers between the No. 1 and No. 2 entries, and 80 feet x 140 feet centers between the No. 2 and No. 3 entries, or 90 x 140 feet centers, for the three entry gateroads.

Arch also commissioned M. Heib (Heib Study) in February 2018 to conduct geotechnical testing and analysis of core holes in the Leer and Sentinel (now Leer South) mines. The report provides information related to horizontal stresses by roof strata, horizontal strain, Brinell

Hardness, fracture trend analysis, Poisson's Ratio, uniaxial compressive strength, and Young's Modulus, which is summarized in Section 7.4. This report provides Arch with information to prepare well designed mine plans recognizing local horizontal stresses, and design roof support measures to provide adequate roof control for the LOM Plan.

Arch utilized the input from the WVU Pillar Study to determine minimum pillar sizes and the Heib Study to determine orientation of maximum horizontal stresses for the LOM Plan.

13.1.2 Hydrogeological Model

Under the original approved mining plan, the Leer Mine was expected, upon completion of mining, to become fully inundated with water, with no gravity discharge. Because of this, the mine pool was expected to increase to 1,320 feet, creating the potential for unconfined seepage. The permit was modified in Revision No. 18 to include a long-term artesian discharge via a wet seal at 1,180 feet. In Revision No. 21, the discharge concept was modified to change the location and elevation of the planned artesian discharge. The water to be discharged at the elevation of the dewatering borehole is expected to be of good quality, with circumneutral pH and total iron concentrations that can readily settle without the use of chemical treatment. Therefore, the additional mining area added in Revision No. 21 will not create a perpetual discharge of water requiring treatment to meet water quality standards. Moreover, the planned artesian discharge will alleviate potential seepage along Three Fork Creek and will allow for centralized management of the effluent from the Leer Mine.

The average water infiltration rate into the Leer Mine void, based upon the expanded reserve area in Revision No. 21, ranges from 1,125 gallons per minute (gpm) to 1,515 gpm based upon two accepted procedures (McCoy and Leavitt equations) for estimating average infiltration. The average of the two infiltration rates, from both methods, would equate to 1,320 gpm. However, for design of the dewatering system and timing requirements, the projected average infiltration rate was increased by 180 percent, resulting in an average infiltration rate of 2,390 gpm.

Projected infiltration rates in response to rainfall, artesian discharge, and pool elevations were determined by Arch utilizing the rainfall distribution by calendar day. The elevation of the starting pool was set at the collar elevation of the dewatering borehole (1,058.7 feet). Most of the increase in the underground pool elevation is a function of the driving head building up to push water out of the artesian system. The evaluation of projected water infiltration rate considered two different situations, one without any of the artesian flow being recirculated into

the mine void and one with the pool discharge limited to 3,465 gpm, with any artesian flow above that being recirculated back into the mine. The projected maximum pool elevation would reach 1,061.6 feet.

Arch had detailed aerial mapping prepared along the area of Three Fork Creek, and Marshall Miller and Associates (MMA) was retained to prepare a subsidence prediction model in that area. The results of the MMA report indicated that the lowest line of zero subsidence from the longwall panels intercepts the surface at a surface elevation of 1,070 feet. Similarly, utilizing the 15-degree angle of critical deformation from the longwall panels, the projected lowest elevation the angle of critical deformation intercepts the surface is 1,068 feet. Utilizing the 1,068 feet elevation as the limiting elevation, the projected maximum pool elevation is 6.41 feet below the projected line of zero subsidence.

To maintain the underground mine pool at or below a maximum elevation of 1,062 feet, it will be necessary to install two angular 18-inch diameter dewatering boreholes. The angular boreholes will provide three benefits: (1) establish a fixed discharge elevation to maximize the recoverable coal resource; (2) eliminate the potential to create an uncontrolled discharge; and (3) significantly reduce or eliminate potential diffuse seepage along the flanks of Three Fork Creek as authorized in the original permit for the Leer mine. The angular boreholes will be installed at the present location of the clean coal stockpile within the currently permitted area in the Rocky Fork tributary of Three Fork Creek, after completion of mining. A flow control valve will be installed at the collar of the dewatering boreholes to regulate the flow, if needed for maintenance activities. The dewatering boreholes will have an elevation at the surface of 1,058.7 feet, which with exception of periods of prolonged drought will be the minimum underground pool elevation. The boreholes will penetrate the mine reservoir at an approximate elevation of 890 feet.

The boreholes will have an artesian discharge, with no pumping necessary to maintain the underground mine pool at a desired elevation. The artesian flow will discharge into two separate retention ponds that are constructed in series. Each pond will be designed and constructed to provide 19 acre-feet of storage capacity.

An additional step to ensure long-term compliance with water quality-based effluent limits (WQBEL) is incorporated into the permit. A pump system designed to limit the discharge from retention ponds to 3,465 gpm will be installed to transfer excess pond decant water back to the slope and return the water to the underground mine void. The pump will be operated as necessary to maintain compliance with effluent limits. The results of the treatability tests and

long-term water quality trends, along with the retention time in the designed storage ponds, indicate that that the operating time and rates on the return pumping system will be limited.

Arch has a work practice that outlines the procedures for properly obtaining field measurements (e.g., pH, flow, etc.) and collecting representative water samples at the Leer Mine permitted property. The procedures described in the work practice pertain to water sampling at the outfalls/outlets and stream monitoring locations. The sampling frequency, outlets/outfalls, stream monitoring locations and associated parameters are summarized in the Leer Mine permits, as well as Arch's Water Discharge Permit Environmental Operating Procedure (EOP). This work practice is intended to improve overall water quality compliance by providing a comprehensive summary of applicable monitoring requirements in the permit, the WV/NPDES rules for coal mining facilities at Title 47, Series 30 (47CSR30), and the EPA regulations under 40 CFR Part 136.

For sample analysis, Arch uses laboratories that follow the most recent approved EPA sampling methodology and procedures. The laboratories have internal quality control and quality assurance protocols that are followed before delivering sample results to the Arch Engineering Department. The Engineering Department then reviews the sample results once again, as a second check for quality control and quality assurance before the results are published.

13.1.3 Other Mine Design and Planning Parameters

Based on geotechnical studies conducted by Arch for the Leer Mine, longwall gateroads developed by the continuous miner sections consist of three entries, with the first gateroad in each longwall district consisting of four entries. The gateroads are typically developed on 80 to 100 feet centers between No. 1 and No. 2 entries, and 90 to 100 feet centers between No. 2 and No. 3 entries. Crosscut centers are typically 140 feet and typical entry widths are 19 feet.

Mains will be developed on entry centers of 70 feet and crosscut centers of 100 feet to 140 feet.

The approved MSHA roof control plan allows maximum entry width of 24.5 feet for the longwall face set up entry, and widths up to 23 feet for dual track spurs where additional roof support will be installed.

The longwall panels will vary in width from 788 feet to a maximum width of 1,185 feet, with longwall panel lengths that vary based on panel geometries constrained by property control or coal thickness less than 3.0 feet. The projected longwall panel lengths range from 3,340 feet to 16,906 feet with planned LOM longwall panel length totaling 231,253 feet and clean recoverable tons for the longwall panels in the Leer Mine LOM Plan totaling 42.6 million tons.

13.2 PRODUCTION, MINE LIFE, DIMENSIONS, DILUTION, AND RECOVERY

13.2.1 Production Rates

Projected continuous miner productivity is 105 feet per shift for gateroad development and 144 feet per shift for the continuous miner supersections. Supersections are continuous miner sections with split ventilation that allows two continuous miners to operate simultaneously. Longwall projected productivity is typically 52 feet of retreat per day (26 feet per shift).

The longwall and continuous miner production crews work nine-hour shifts, two shifts per day, with hot seat change at the section face. A third shift per day for the longwall and continuous miner units is utilized for maintenance. Each continuous miner crew works a five- and one-half day schedule (every other Saturday). There are four longwall crews that work a five days on, three days off schedule, rotating shifts every six weeks to provide longwall production seven days per week.

Actual ROM and clean production, preparation plant yield and productivity achieved by the Leer Mine longwall mining unit and the continuous miner units average for 2019 and 2020 are shown in Table 13.3.1-1 as follows:

Table 13.2.1-1 Leer Mine Historical ROM and Clean Production, Preparation Plant Yield, and Productivity

	2019-2020 Average
ROM Tons (000s)	8,950
Clean Tons (000s)	4,230
Preparation Plant Yield (%)	47.3
Productivity (Feet of Advance/Shift):	
Longwall [(1)]	27
Continuous Miners	99

[(1)] Feet of Retreat/Shift

Production from the longwall mining unit is projected to range from 135,162 to 480,312 clean tons per month, except for months having a longwall move or holidays. Annual longwall production will vary depending on coal seam thickness, mining height and the number of longwall moves each year. A production delay of 12 days is projected for all longwall moves.

Production from the continuous miner units is projected to range from 6,167 to 94,668 clean tons per month, depending on the number of shifts required to develop main entries and gateroads to support longwall mining. Planned mining height for the continuous miners is 9.0 feet.

The Leer Mine produced approximately 4.1 million clean tons in 2020 and 4.4 million clean tons in 2021 and projects total mine production to range from 2.8 to 5.1 million clean tons when the longwall and continuous miner units are operating (2022 to 2034) and 2.9 million clean tons per year in 2035 after the continuous miner units cease production in 2034.

Arch's projected clean production for the longwall and the continuous miner units for the Leer Mine LOM Plan are shown in Table 13.2.1-2 as follows:

Table 13.2.1-2 Leer Mine LOM Plan Projected Clean Production

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
Clean Tons (000)															
Longwall	3,504	3,526	3,808	4,186	2,881	2,833	2,805	2,674	2,484	2,307	2,619	2,472	2,805	2,850	41,753
Continuous Miners	762	802	1,040	921	741	607	497	416	494	470	527	404	84	-	7,764
	4,266	4,328	4,848	5,107	3,622	3,440	3,302	3,090	2,978	2,777	3,146	2,876	2,889	2,850	49,518

13.2.2 Expected Mine Life

Current Leer Mine LOM Plan projects mining through October 2035, an expected mine life of 13 years (see Figure 13.5-1). It is important to note that the LOM Plan is based on information provided by the company and does not contemplate development of surrounding reserves the company currently controls or contiguous reserves the company could acquire in the future, nor does it assume any productivity improvements, technological innovations and/or operating efficiencies that the company has achieved historically.

13.2.3 Mine Design Dimensions

LOM Plan projects continuous mining units operating at the Leer Mine through May 2034 and the longwall mining unit through October 2035.

The longwall panels will typically be 1,185 feet wide, with panel lengths ranging from 4,310 feet to 16,906 feet in the LOM Plan. Several of the longwall panels are narrower than 1,185 feet, having widths ranging from 788 feet to 1,104 feet to accommodate resource geometry and seam thickness variations.

The projected mining for the LOM Plan is shown on Figure 13.5-1.

Mine design criteria utilized in the LOM Plan is as follows:

- Gas Wells
  - Ø State Permit required to mine within 500 feet of a well
  - Ø MSHA Permit required to mine within 150 feet of a well
  - Ø Active Wells - tangent of 8 degrees x depth of cover or 50 feet, whichever is greater
  - Ø Inactive Wells - tangent of 4 degrees x depth of cover or 50 feet, whichever is greater
  - Ø Plugged Wells - mine through permitted with State and MSHA Permits

- Pillar Size
  - Ø Analysis of Retreat Mining Pillar Stability (ARPMS) stability factor of 2.5 or greater for mining under public buildings or impoundments.
  - Ø ARMPS stability factor of 2.0 or greater for long life areas and under residences in areas where subsidence is not planned.
  - Ø ARMPS stability factor of 1.5 or greater for all other room and pillar development.
  - Ø ALPS(R) tailgate loading stability factor of 1.3 or greater for longwall mining.

- Depth of Cover
  - Ø In general, longwall mining will not be conducted in areas with less than 200 feet of cover. This may be evaluated on a case-by-case basis.

- Areas without Subsidence Rights
  - Ø ARMPS stability factors of 2.0 or greater will be maintained during first mining.
  - Ø Retreat mining will come no closer than a tangent of 30 degrees times depth of cover to the property boundary.
- Coal Thickness
  - Ø In general, mining will not be planned in areas of coal less than 3.0 feet in thickness. This may be evaluated on a case-by-case basis.

- Ø Continuous miner units are assumed to mine entire seam thickness (averaging 5.0 feet, ranging from 0.0 to 9.0 feet). Mining height required for ventilation tubing and longwall equipment transportation is a minimum of 8 feet, but is modeled at 9.0 feet.
- Ø Longwall is assumed to mine the entire seam up to 8.0 feet (maximum mining height is 8.5 feet). Anything over that is assumed to be left behind. Typical mining height for the longwall is 6.5 feet, but is modeled at 7.0 feet.

13.2.4 Mining Dilution

OSD on continuous miner units is typically 2.0 to 3.0 feet from roof or floor. Longwall OSD is based on a minimum mining height of 6.5 feet, which typically results in OSD of 0.5 to 1.5 feet from roof or floor. Minimum dilution is 0.5 feet when the seam height is greater than the minimum mining height and typically involves floor material.

13.2.5 Mining Recovery

The longwall is projected to recover 100 percent of the in-place coal within the area projected to be mined from the starting and stopping point between the two gateroads. Typically, the longwall mines the coal seam up to a maximum mining height of 8.5 feet.

The continuous miner recovery is based on the pillar design and varies based on whether the panel is a gateroad, main entry or production panels. Typical continuous miner aerial recovery varies from approximately 30 to 60 percent for the LOM Plan. The continuous miners' maximum mining height capabilities will have the capacity to recover the entire seam thickness over the entire LOM Plan.

13.3 DEVELOPMENT AND RECLAMATION REQUIREMENTS

13.3.1 Underground Development Requirements

The Leer Mine is an active mine. As the mine expands, future development will be required for extensions of belt conveyors, mine power, pipelines, track, and ventilation overcasts. In addition, development into the northern extension of the Leer Mine reserve area will require additional ventilation shafts and infrastructure facilities.

Future bleeder shafts are anticipated for each of the remaining six longwall districts. Existing fans will be decommissioned from one longwall district and moved to the next to save costs. Each bleeder shaft and fan installation will be completed just prior to starting the longwall in

each district. Two new return shafts without fans are anticipated, one for the eastern reserves south of Three Fork Creek (to be constructed in 2021-2022), and one for the northern extension of the Leer Mine reserve, north of Three Fork Creek (to be constructed in 2023). An additional intake shaft is anticipated for the northern extension of the Leer Mine reserve, north of Three Fork Creek (to be constructed in 2023-2024).

A new refuse disposal facility will be needed by 2028. It is estimated that the new refuse disposal site will cost approximately $20 million to develop. This includes land acquisition, geotechnical investigations, permitting, clearing, and starter dam construction. WEIR is not aware of any obstacles or concerns that may impair Arch's ability to secure approvals and construct this facility.

13.3.2 Reclamation (Backfilling) Requirements

The construction of the Leer Mine required the removal of an estimated 2.2 million cubic yards (swelled) of material to create an adequate working surface for the valley fill, road fill, underground mine face-up, slope, shaft, haul roads, access roads, load-out facility, preparation plant facility, storage, coal stockpiles, and truck scales. Upon mine closure, selected areas will be reclaimed to near their Approximate Original Contour (AOC). Other areas will be left in-place as per the approved alternate post-mining land use requests. Regrading and backfilling activities will commence within 180 days after the mining operations are complete.

There are six openings to the surface from the Leer Mine. These openings consist of the slope, dual intake and elevator shaft, return shaft, two bleeder shafts (District 5 and Sharp), and the Hardesty intake shaft. Once mining operations terminate, the shafts will be sealed by filling with earth, rock, and rubble from the coal seam to the surface, after which a 8-inch-thick concrete cap will be poured at the surface, prior to backfilling, regrading, and seeding. The slope will be sealed by building a wet seal at the portal, prior to backfilling, regrading, and seeding.

Upon completion of mining, mine soil material will be utilized to return selected areas of the site to AOC. The mine soil material will include topsoil, subsoil, and mixed overburden material that was removed during the construction of the access roads, underground mine site, and preparation plant site. Upon completion of mining operations and regrading, the mine soil will be redistributed over the selected areas. Mine soil that served as a base for coal stockpiles in the preparation plant area will be tested to determine if supplemental liming is necessary prior to blending this material with the other mine soil onsite. After the permit area has been graded, soil analysis will be performed to determine the quantity of agricultural limestone, or

an equivalent supplement, and fertilizer necessary to achieve the post-mining land use. A soil analysis will be performed prior to seeding for each phase of mine reclamation.

13.4 MINING EQUIPMENT AND PERSONNEL

13.4.1 Mining Equipment

Currently, there are three longwall development (gateroad) continuous miner sections and one continuous miner supersection developing mains and production panels. The Leer Mine is currently utilizing the following industry standard mining equipment on the continuous miner units, as shown in Table 13.4-1.

Table 13.4.1-1 Continuous Miner Section Equipment

Gateroad Continuous Miner Unit	Continuous Miner Supersection Unit
1 - Joy 14CM15 Continuous Miner	2 - Joy 14CM15 Continuous Miners
2 - Narco 10SC32 Shuttle Cars	3 - Narco 10SC32 Shuttle Cars
1 - Fletcher CHDDR15 Roof Bolters	2 - Fletcher CHDDR15 Roof Bolters
1 - Fairchild 35C Battery Scoop	2 - Fairchild 35C Battery Scoops
1 - Feeder Breaker	1 - Feeder Breaker
2 - Auxiliary Face Fans	4 - Auxiliary Face Fans

Arch purchased and installed a state-of-the-art Joy longwall mining system for the Leer Mine, which incorporates technological advances in equipment component capacity, strength and durability. The longwall mining system consists of the following equipment shown in Table 13.4.1-2.

Table 13.4.1-2 Longwall Mining Equipment

Longwall Section
212 - Joy Roof Support Face Shields, 1,040-Ton Capacity (1.5 meter wide)
1 - Joy 7LS1D Shearer
1 - Joy Armored Face Conveyor (1,200 feet)
1 - Stageloader
1 - Crusher
1 - Tailpiece with Pontoons
1 - Scoop
1 - Power Center, 7,000 KVA
1 - Power Center, 3,000 KVA
4 - Kamat Pressure Pumps, 100 gpm each

The Leer Mine longwall mining system is capable of operating at the widths and lengths projected by Arch.

No changes are planned in the type of mining equipment used during the Leer Mine LOM Plan. The longwall is projected to cease operation in 2036, after mining all the projected longwall panels.

Four to five continuous miner sections will continue mining through 2030, two continuous miner sections will operate through 2032, and the last continuous miner section is projected to cease operating in 2033.

13.4.2 Staffing

The Leer Mine staffing as of February 2021 was comprised of 455 salary and hourly employees associated with the mine and 46 salary and hourly employees associated with the preparation plant.

The Leer Mine is scheduled to produce coal two production shifts each day, A Shift and B Shift. Crews on the Owl or idle shift provide support services including production unit moves, off-shift maintenance and other support functions as required. In addition, general underground support crews work each shift performing routine supply, belt maintenance and outby support functions. Hourly personnel are not affiliated with any union, with no anticipated changes in the near term.

The preparation plant is staffed with three crews to process ROM coal 24 hours per day, six to 6.5 days per week. Each crew works three, 12-hour shifts and is off for two days. Shut down periods are typically July 4th week, Thanksgiving week, Christmas Eve and Christmas Day.

The projected staffing level for the LOM Plan is expected to remain similar to the current staffing level through 2032 and then will taper off through the end of the LOM Plan in 2035.

Most of the employees live nearby in Preston and Taylor Counties. Arch has had no major issues hiring qualified candidates for open positions and relies considerably on employee referrals.

Mine Safety

An industry standard for safety performance is the Non-Fatal Days Lost (NFDL) Incidence Rate, which is determined by the number of lost time injuries multiplied by 200,000 divided by the manhours worked.

The Leer Mine (excluding the preparation plant) manhours worked, NFDL injuries, and NFDL Incidence Rate reported to the MSHA for 2018 through Third Quarter 2021, compared to the national average NFDL Incidence Rate for United States underground coal mines are shown in Table 13.4.2-3 as follows:

Table 13.4.2-3 Leer Mine Manhours Worked, NFDL Injuries and NFDL Incidence Rate

		NFDL Injuries		NFDL Incidence Rate	
	Manhours Worked	Leer	Contractor	Leer	National Average
2018	1,113,142	1	-	0.18	3.18
2019	1,122,624	-	1	-	3.05
2020	1,144,218	11	-	1.92	3.14
2021 [(1)]	867,860	2	-	0.46	NA

[(1)] As of Third Quarter YTD

The Leer Mine NFDL Incidence Rate was significantly lower than the national average from 2018 through 2020. The Leer Mine received the Sentinels of Safety Award, an industry accolade, in the large underground mine category, having worked all of 2019, and a total of more than 2 million manhours, without a lost time incident.

The Leer Preparation Plant manhours worked, NFDL injuries, and NFDL Incidence Rate reported to the MSHA for 2018 through Third Quarter 2021, compared to the national average NFDL Incidence Rate for United States preparation plants are shown in Table 13.4-6 as follows:

Table 13.4.2-4 Plant Manhours Worked, NFDL Injuries and NFDL Incidence Rate

		NFDL Injuries		NFDL Incidence Rate	
	Manhours Worked	Leer Plant	Contractor	Leer Plant	National Average
2018	102,670	-	1	-	1.77
2019	104,148	-	1	-	2.03
2020	105,891	1	-	1.89	1.78
2021 [(1)]	81,892	-	-	-	NA

[(1)] As of Third Quarter YTD

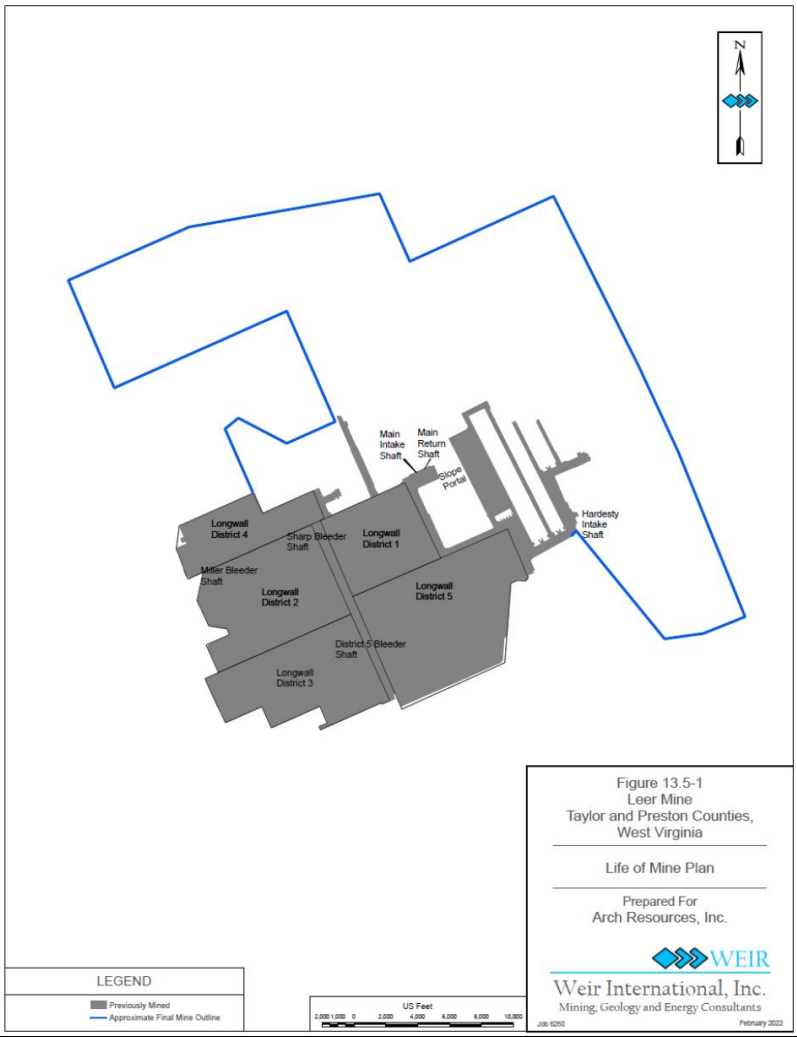
Only one injury was incurred at the preparation plant in 2018 through 2020, which resulted in the NFDL Incidence Rate of 1.89 compared to the national average of 1.78 for 2020.

Leer Mine management personnel are very proactive in providing a safe working environment for all personnel. As an example, the breathing apparatus for use at the Leer Mine in case of firefighting is a Draeger Self Contained Breathing Apparatus (SCBA). Other breathing apparatus to be used in case of mine evacuation, include the Ocenco M-20 units, providing 10 minutes of oxygen are worn on the miner's belts and the Ocenco EBA 6.5 SCSRs, providing 60 minutes oxygen, which are available on the underground transport vehicles, at 5,700 feet intervals along the escapeway and at the underground belt drives.

13.5 LIFE OF MINE PLAN MAP

The projected mining for the Leer Mine LOM Plan is shown on Figure 13.5-1.

Figure 13.5-1 Life of Mine Plan



14.0 PROCESSING AND RECOVERY METHODS

14.1 PLANT PROCESS

The preparation plant consists of two identical processing circuits, with primary and secondary heavy media cyclones, classifying cyclones, spirals, reflux classifiers, and column flotation. The ROM material size fractions and circuits utilized are summarized in Table 14.1-1 and are more fully described in Section 14.2.

Table 14.1-1 Plant Process Size Fractions and Circuits

Size Fraction	Size	Feed %	Circuit
Coarse	2 in. x 1mm	73	Heavy Media Cyclone
Fine	1mm x 100 Mesh	20	Reflux Classifiers
Ultrafine	100 Mesh x 325 Mesh	5	Column Flotation
Ultrafine	325 Mesh x 0	2	Discard
Secondary	2 in. x 1mm		Heavy Media Cyclone

14.2 PLANT PROCESSING DESIGN, EQUIPMENT CHARACTERISTICS AND SPECIFICATIONS

The Leer Preparation Plant, built by Powell Construction, is a well designed and constructed, state-of-art technology preparation plant. The preparation plant was designed with two identical processing circuits, which can be operated simultaneously or one at a time. Each circuit can process 700 ROM tph of raw coal for a total design feed rate of 1,400 ROM tph, although the preparation plant typically operates at 1,500 ROM tph (750 to 775 ROM tph per circuit). The preparation plant feed rate is adjusted based on the desired product quality, which often results in the preparation plant's processing rate to be higher than the design rate.

ROM material is conveyed from the slope belt conveyor to the Raw Coal #1 or Raw Coal #2 stacking tube. The ROM material is reclaimed from the stacking tubes and is sized at a nominal 2 inch top size. All of the -2 inch material reports to the plant feed conveyor where it is conveyed to the plant feed surge bin prior to processing.

The material from the surge bin reports to the raw coal screens where it is screened at +2 inch, 2 inch x 1mm and 1mm x 0. The +2 inch is discarded onto the rejects conveyor. The 2 inch x

1mm is washed in a heavy media cyclone at 2 inch x 1mm. The fine 1mm x 100M material is washed via reflux classifiers. The ultrafine 100 mesh x 325 mesh material is cleaned by column flotation. The +1mm material is washed at a high gravity first to reject the rock. This +1mm product is then re-washed at a low specific gravity in a heavy media cyclone resulting in a metallurgical coal product and a secondary middlings product.

Coarse reject material is conveyed to and stored in a bin, then trucked to the refuse disposal site. Fine reject material is pumped from the thickener to the impoundment for disposal.

To ensure the desired saleable product quality is being produced from the preparation plant, daily proximate analyses, weekly petrographic analyses, bi-weekly ash/mineral analyses, and bi-monthly plant efficiency testing are conducted.

The middlings product contains coal that is typically 9,000 to 11,500 Btu/lb, with an ash level of 17 to 30 percent and sulfur content of 1.8 to 2.2 lbs. SO_2/MBtu. This product is primarily utilized by power plants as a blend with other feed coals.

The preparation plant washes all the ROM coal and can process ROM coal to a 100 percent metallurgical coal product, or to an 87.5 percent metallurgical coal and 12.5 percent middlings product.

The preparation plant operates two, 12-hour shifts per day, six to six and one-half days per week, and typically processes 35,000 to 36,000 ROM tons per day. Shut down periods are typically July 4th week, Thanksgiving Week, Christmas Eve, and Christmas Day.

The current stage of the refuse disposal site is 7 of 10 designed stages. Stage 8 was approved by the MSHA on July 20, 2020. Placement of coarse refuse is being done in a workmanlike manner, in accordance with approved refuse disposal plans.

The preparation plant and coal handling facilities consist of the following equipment shown in Table 14.2-1:

Table 14.2-1 Major Preparation Plant and Material Handling Equipment

ROM Coal Handling System:
- 2 - ROM Stockpiles
- 1 - ROM Reclaim Tunnel, 630-Feet
- 4 - Belt Scales
- 2 - Tram Iron Magnets
- 1 - Raw Coal Sizer
- 1 - Single Stage Sweep Sampler
- 1 - Surge Bin, 150-Ton Capacity

Preparation Plant:
- 2 - Raw Coal Deslime Screens, 14-Feet x 24-Feet Double Deck
- 2 - Primary Heavy Media Cyclones, 1.15-Meter Diameter
- 2 - Refuse Drain and Rinse Screens, 14-Feet x 20-Feet Double Deck
- 2 - Steam Coal Drain and Rinse Screens, 14-Feet x 20-Feet Single Deck
- 2 - Secondary Heavy Media Cyclones, 0.9-Meter Diameter
- 2 - Met Coal Drain and Rinse Screens, 14-Feet x 20-Feet Single Deck
- 2 - Midds Coal Drain and Rinse Screens, 10-Feet x 20-Feet Single Deck
- 2 - Met Coal Centrifuges, Ludowici 1500
- 2 - Midds Coal Centrifuges, Ludowici 1400
- 2 - Banks of 6 Raw Coal Classifying Cyclones, 15-Inch Diameter
- 4 - Primary Reflux Classifiers
- 2 - Secondary Reflux Classifiers
- 2 - Banks of 6 Triple Start Compound Spirals
- 2 - Banks of 8 Effluent Cyclones, 6-Inch Diameter
- 2 - High Frequency Refuse Screens, 8-Feet x 12-Feet
- 2 - Primary Column Flotation Cells, 15-Feet x 24-Feet
- 2 - Secondary Column Flotation Cells, 15-Feet x 24-Feet
- 2 - Banks of 32 Deslime Cyclones, 6-Inch Diameter
- 3 - Met Coal Screen Bowl Centrifuges, 44-Inch Diameter x 132-Inches
- 1 - Midds Coal Screen Bowl Centrifuge, 44-Inch Diameter x 132-Inches
- 1 - High Rate Thickener, 140-Feet Diameter
- 6 - Magnetic Separators, 48-Inch Diameter x 10-Feet
- 1 - Magnetic Separators, 36-Inch Diameter x 6-Feet
- 2 - Magnetite Bins, 100-Ton Capacity

Clean Coal Handling System:
- 2 - Belt Scales
- 2 - Two Stage Clean Coal Samplers
- 1 - Midds Coal Stockpile
- 2 - Clean Coal Stockpiles
- 1 - Reclaim Tunnel, 620-Feet
- 1 - Tertiary Clean Coal Sampler
- 1 - Batch Weigh Rail Loadout

Refuse Handling System:
- 1 - Refuse Conveyor, 42-Inch
- 1 - Refuse Bin

Total stockpile capacity at the Leer Mine is 400,000 tons of ROM coal and 300,000 tons of clean coal.

14.3 ENERGY, WATER, PROCESS MATERIALS, AND PERSONNEL REQUIREMENTS

The preparation plant consumes approximately 4.9 million kilowatt-hours of electricity/month. Water requirements are approximately 1,800 gpm of make-up water with a closed-loop water system. The preparation plant pumps fine slurry to the refuse slurry impoundment and then clarified water is pumped from the refuse slurry impoundment back to the plant.

Magnetite consumption is approximately 0.60 pounds per ROM ton processed. The preparation plant chemicals utilized cost approximately $0.08 per ROM ton processed.

Personnel requirements to operate the processing shifts at the preparation plant are one salary and nine hourly employees per shift. In addition, there are four salary and two hourly personnel that perform administrative and maintenance duties associated with the preparation plant.

15.0 INFRASTRUCTURE

15.1 ROADS

Access to the Leer property is off of U.S. Route 50, east of the town of Grafton in Taylor County, West Virginia. The nearest cities are Morgantown, West Virginia to the north and the cities of Clarksburg and Bridgeport, West Virginia to the west. The property can be accessed from Morgantown via U.S. Route 119 to Grafton. Morgantown is located 25 miles north of Grafton. The property can be accessed from Bridgeport via U.S. Route 50. Bridgeport is located 16 miles west of the Leer Mine.

15.2 RAIL

The Leer Mine transports coal via the CSX railroad, which operates the Mountain Subdivision railway from Cumberland, Maryland through Grafton, West Virginia. CSX operates a rail yard at Grafton, West Virginia.

15.3 POWER

Electrical power for the Leer Mine is provided by FirstEnergy Corp. subsidiary Mon Power through a 138 kV transmission line. A contract with Mon Power provides electrical power under Rate Schedule K.

15.4 WATER

The Tygart Valley River lies to the west of the Leer Mine Property. The Tygart Valley River is not navigable for commercial traffic.

Over half of the water required for mine operations such as mine dust suppression and preparation plant make up water is provided by recycling. The remainder is provided by a pump station installed beside Three Fork Creek, a tributary of Tygart Valley River, and is pumped to a million-gallon head tank. There is no contract or monthly charge for the water from Three Fork Creek. Potable water for the facilities is obtained from the Taylor County Public Service District at an average monthly charge of $12,000.

15.5 PIPELINES

A water pipeline from the Taylor County Public Service District provides potable water to the Leer Mine offices and bathhouse facilities.

There is no natural gas service to any of the facilities.

A 12-inch diameter slurry pipeline with four, 200 hp motors pumps slurry from the thickener at the preparation plant to the refuse slurry impoundment.

15.6 PORT FACILITIES, DAMS, AND REFUSE DISPOSAL

Port Facilities
Arch ships the Leer Mine metallurgical coal to either the CSX Chesapeake Coal Terminal or the Dominion Terminal Associates LLP (DTA) for export to customers.

CSX owns and operates the CSX Chesapeake Coal Terminal transshipping facility located at Curtis Bay, Maryland and is the primary facility used by the Leer Mine. Arch Coal Sales, Inc. (ACS), a subsidiary of Arch, has a rail contract and throughput arrangement with CSX through 2024, with dedicated storage capacity of approximately 200,000 tons of saleable coal. In 2020, Arch shipped 1.73 million tons from the Leer Mine through the facility, which serves as a transload facility for the export of utility and metallurgical coals and is served by the CSX rail line. Annual throughput capacity of the CSX facility is 11 to 13 million tons and Arch projects shipping 2.2 million tons from the Leer Mine through the facility in 2021.

The DTA coal shipping and ground storage facility is located in the port of Hampton Roads on the East Bank of the James River in Newport News, Virginia. DTA has state-of-the-art sampling and blending systems. Arch, through its subsidiary, Ashland Terminals, owns 35 percent of DTA, with the remainder owned by Contura Energy. CSX delivers unit trains from eastern United States coal mines and DTA has ground storage capacity of 1.7 million tons, with coal segregated in storage areas by coal type and shipper. Arch controls approximately 600,000 square feet of ground storage space and depending on the number of stockpiles can store between 350,000 and 560,000 tons of coal.

In 2020, Arch shipped 753,000 tons from the Leer Mine through DTA. Arch projects shipping 700,000 tons from the Leer Mine through DTA in 2021 and has the capacity to ship much more

if needed. DTA accommodates seagoing vessels and coastal barges and colliers of up to 177,000 DWT. Pier length is 1,162 feet with berths for loading on either side. Both berths are dredged to a mean low water depth of 50 feet to match the harbor channel.

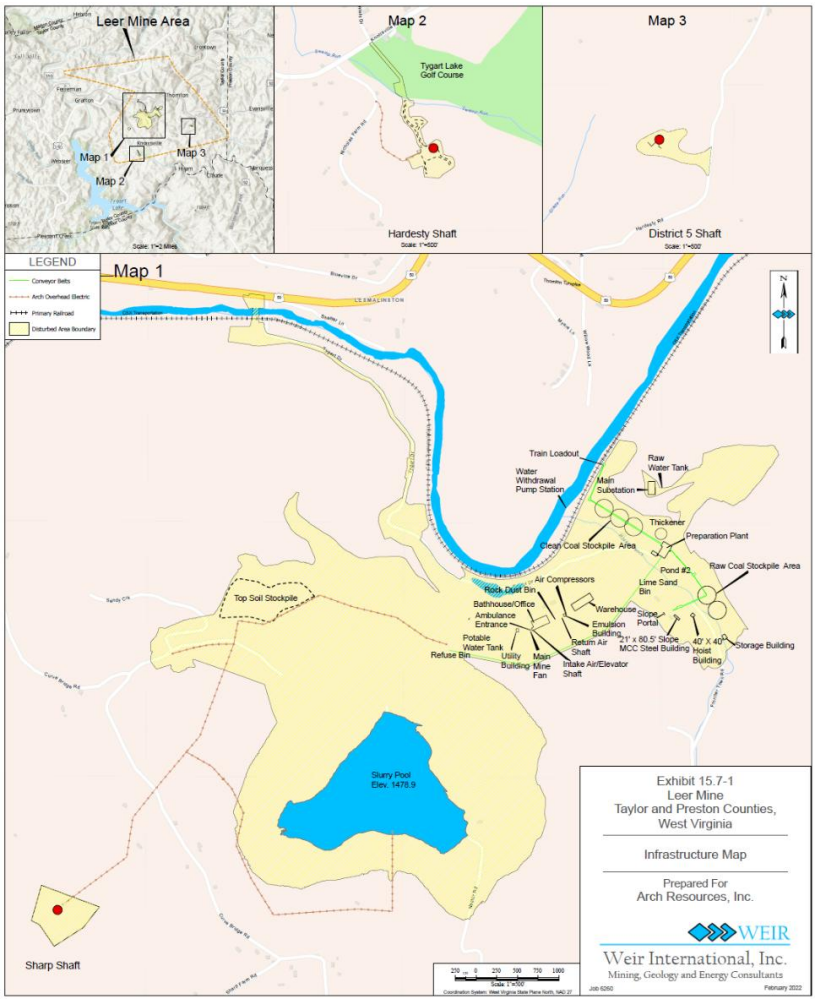
Dams and Refuse Disposal

Coarse refuse is conveyed to the refuse disposal site and fine refuse is pumped from the preparation plant thickener to a designed slurry cell at the refuse disposal area. The current stage of the refuse disposal area is 7 of 10 designed stages. Stage 8 was approved by the MSHA on July 20, 2020. Coarse refuse capacity is projected to last through May 2031 at which time Leer will have permitted and constructed a new refuse site in Rocky Branch. There is adequate coarse and fine refuse disposal capacity at Rocky Branch to serve the LOM Plan.

15.7 MAP OF INFRASTRUCTURE

The Leer Mine infrastructure is summarized below on Figure 15.7-1, with a detailed map provided on Exhibit 15.7.-1.

Figure 15.7-1 Mine Infrastructure



16.0 MARKET STUDIES

16.1 MARKETS

Overview

The Leer Mine produces a high quality, high volatile metallurgical coal. Historically, the market for metallurgical coal from the Leer Mine has been domestic metallurgical coal consumers and the global seaborne metallurgical coal market. Production from the Leer Mine is a high volatile A coal, as well as a middlings product.

A summary of the various classifications of coal from the Leer Mine is as follows:

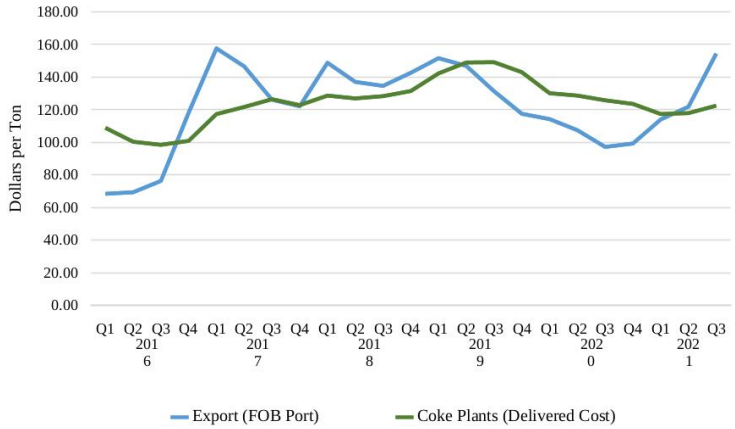
High volatile metallurgical coal contains more than 31 percent volatile matter and is typically represented as high volatile A and high volatile B coal. A third class of high volatile metallurgical coal is referred to as high volatile C, which has calorific, sulfur and petrographic quality considerably less than high volatile A and B metallurgical coals. High volatile metallurgical coal, primarily high volatile A and B coals, serve both the domestic and global seaborne metallurgical coal markets. The Leer Mine sells a high volatile A metallurgical coal.

Metallurgical Historical Coal Sales Prices

Coal sales prices are influenced by many factors, including domestic supply and demand, global supply and demand dynamics, productivity, cost of competing fuels, transportation, and inflation, both mining cost inflation and general inflation.

The market for US metallurgical coal consists of both domestic metallurgical coal consumers and exports into the global seaborne metallurgical coal market. The US Energy Information Administration (EIA) compiles average historical price data for metallurgical coal delivered to domestic coke plants and metallurgical coal delivered to tidewater terminals for export. Note that the EIA data includes all classifications of metallurgical coal (high, mid and low volatile) as well as both spot and contract sales prices. The historical prices for metallurgical coal are shown on Figure 16.1-1 as follows:

Figure 16.1-1 Metallurgical Coal Sales Prices



Source: EIA Quarterly Coal Report

Between 2016 and Third Quarter 2021, export prices (FOB Port) and domestic coke plant prices (delivered cost) have averaged $120.33 and 124.41 per ton, respectively.

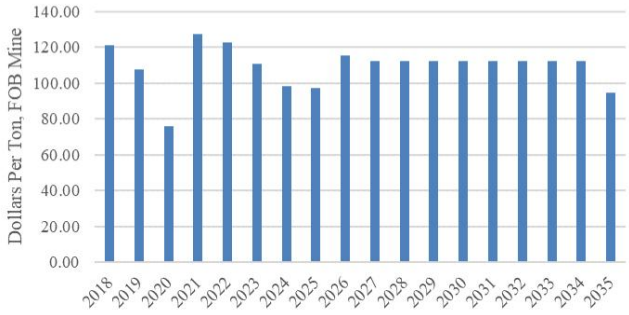
Arch expects strong ongoing demand for the Leer Mine metallurgical coal over the next two decades and across the remaining life of the Leer Mine reserve base. The primary driver for this positive view is Arch's bullish outlook on global steel production over this timeframe, coupled with ongoing degradation and depletion of high-quality metallurgical coal reserves around the world.

On the demand side, Arch sees robust, ongoing increases in steel production in developing economies such as India, coupled with relatively stable demand requirements in already developed economies such as Europe and the U.S. Importantly, Arch believes the developing world will continue to be highly reliant on "new steel" (i.e. steel produced in blast furnaces using coke made from metallurgical coal) as opposed to recycled steel produced in electric arc furnaces that rely primarily on electricity and scrap metal. This assumption is based on the understanding that developing economies are still at the outset of the industrial development curve and have little scrap available for recycling purposes. Moreover, Arch expects high-quality steel produced in blast furnaces to continue to dominate key steel market segments, including automotive.

In 2020, integrated steel production using coke made from metallurgical coal is responsible for 75 percent of global steel supply, and Arch sees that remaining relatively stable in the near to intermediate term. In addition, Arch believes that a significant amount of new steel will be required in a de-carbonizing world, given steel's importance in urbanization, infrastructure replacement and the construction of essential de-carbonization tools such as mass transit systems, wind turbines and electric vehicles. Moreover, Arch believes that the highest-quality metallurgical coals will continue to enjoy a significant advantage in the marketplace, for several reasons. First, the use of high-quality coking coals in coke blends facilitates the most efficient, and thus lowest carbon, steel-making process. Second, the Leer Mine metallurgical coal product is particularly valuable to steelmakers seeking to produce a strong coke despite the use of a wide range of metallurgical coals in their coke blends. Finally, the highly competitive cost structure of the Leer Mine means that it can remain competitive, and continue to earn an attractive margin, even during challenging market environments, or in the event that metallurgical demand should begin to contract at some point in the future.

The 2018 through October 2021 actual and 2022 through 2036 forecasted coal sales price for the Leer Mine utilized in the LOM Plan financial model is shown on Figure 16.1-2.

Figure 16.1-2 Historical and Forecast Coal Sales Price



Note: 2018 through October 2021 are actual

The projected coal sales price in the Preliminary Feasibility Study is based on a high volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

16.2 MATERIAL CONTRACTS

The Leer Mine saleable product is marketed by ACS, a subsidiary of Arch. ACS has offices in St. Louis, Missouri, London, and Singapore. Most of the sales contracts are 12 months in length. North American contracts are typically on a calendar year basis while most of the international coal sales contracts are on a fiscal year beginning in April.

The Leer Mine 2020 and 2021 metallurgical coal sales were sold to customers in regions as shown in Table 16.2-1.

Table 16.2-1 Historical Metallurgical Coal Sales by Region

	Sales (million tons)	
Customer Region	2020	2021
North America	1.1	1.1
Asia	0.8	1.5
Europe/South America	1.6	1.6
	3.5	4.2

ACS has a long-term contract with CSX Corporation for export shipments and throughput at the Curtis Bay Terminal in Baltimore, Maryland through the end of 2024. As a general rule, most North American customers hold their own rail contracts.

16.3 PRICE FORECAST

Leveraging its historical marketing and selling of Leer Mine coal production, Arch prepared forecasts for its planned LOM production. Arch forecasts the Leer Mine High Volatile A metallurgical coal product to sell for an average price of $119.00 per ton between 2022 and 2035. Its middlings product, over the same time period, is expected to sell for $27.16 per ton. Overall average price realization per ton for the Leer Mine metallurgical coal is forecasted at $110.18 per ton.

17.0 ENVIRONMENTAL STUDIES, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS AGREEMENTS

17.1 ENVIRONMENTAL STUDIES

As part of the permitting process required by the WVDEP, numerous baseline studies or impact assessments were undertaken by Arch. These baseline studies or impact assessments included in the permit are summarized as follows, with pertinent text from the permit replicated below:

- Groundwater Inventory
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

Groundwater Inventory

Arch conducted an extensive survey to inventory water use and determine the extent and purpose of ground water usage in the subject area. The analysis delineated surface drainage watersheds and used them as organizational units in the database. Field teams made door-to-door visits to every residence to gather information set forth on questionnaire forms regarding water supply source(s), extent of reliance, purpose of reliance (domestic, agricultural, etc.), depth of well(s), character of springs, and other data. The teams took photographs at each supply source point. The teams measured water level depths in wells where possible and surveyed locations with hand-held GPS.

The following Table 17.1-1 summarizes results of the survey, as to usage. The “industrial” usage category in this instance refers largely to agricultural use for livestock watering supplies. Other “industrial” uses in the subject area include a kennel, a butcher shop, and a golfing facility.

Table 17.1-1 Groundwater Inventory

Use	Spring	Well
Industrial [Predominantly Agriculture]	263	12
Domestic	43	90
Potable	5	5
Recreation	27	-
Unknown	9	10
Unused	111	-
Industrial/Domestic	7	3
Industrial/Domestic/Potable	11	-
Industrial/Potable	1	123
Industrial/Recreational	1	-
Domestic/Potable	27	102
Domestic/Potable/Recreation	5	-
Wildlife	1	-
Being Developed	1	3
Other	16	-
Total	528	348

Baseline ground water monitoring has been conducted at 32 locations throughout the subject area, 13 of which are springs, while the remaining 19 are water wells. Most of those stations were initially monitored beginning in October 2005. Thirty-four additional ground water stations were monitored on a one-time basis, 24 of which are wells, while the remaining 10 are classified as springs. Results of the groundwater inventory are included in the permit.

Surface Water Quality and Quantity

Baseline surface water monitoring for flow and quality parameters has been conducted at 82 locations throughout the permit area. Four of those stations are Baseline Water Quality (BWQ) monitoring only, 11 are a combination of BWQ and Probable Hydrologic Consequence (PHC) baseline monitoring, while the remaining 67 are PHC monitoring only. The BWQ stations were monitored twice monthly until 12 flowing or no-flow monitoring events were observed, whichever occurred first. PHC monitoring was conducted monthly for six consecutive months. Surface water baseline data is found in the permit.

Daily rainfall readings were recorded utilizing an automated rainfall measuring and recording system. The rain gauge was installed at a location situated within a three-mile radius of all BWQ sampling stations. Rainfall summary data is found in the permit.

Probable Hydrologic Consequences

Planned subsidence will occur quickly as the longwall face advances. It is expected that direct fracturing of overburden will extend up through the shale-dominated sequence lying between the Lower Kittanning Seam and the base of the Mahoning Sandstone. Given its distance above the mine (more than about 30 times the mining height) and its competency, neither the Mahoning Sandstone, or the Buffalo Sandstone unit above it, is expected to undergo significant, if any, direct fracturing. It will, instead, exhibit broad sagging and dilation of bedding planes, with consequent increased porosity (increased storage capacity) and lateral permeability in response to mining.

The general or overall effect of the planned mining will be to induce direct fracturing of the shale-dominated strata, up to roughly the base of the Mahoning Sandstone or its horizon. The little water that is present in that strata will be drained to the mine, but the shale interval contains no significant aquifers other than, perhaps, the Lower Kittanning Seam itself, which appears to be penetrated by a few wells located at the extreme southern and northern fringes of the property, well outside the area of planned mining.

The Buffalo-Mahoning sandstone interval is situated in what will be the dilated zone of subsidence, where storage will be increased, and water levels will initially fall. In that zone, downward leakage to the underlying fractured zone will be at a very low rate, and likely will be exceeded by combined vertical and lateral recharge, such that water levels in that dilated zone will gradually recover to, or nearly to, the pre-mining levels.

Above the Pittsburgh Redbeds, strata will be constrained and remain, in general, hydrologically unaffected by subsidence. Only in the very near-surface interval where no lateral constraint occurs is there likely to be any significant disturbance hydrologically. In that zone, water moving at local base level (such as that moving through stress-relief fractured and/or weathered rock beneath small upland stream valleys) will likely remain unaffected in the long term, but water moving through perched aquifers to discharge as hillside springs or seeps may be relocated to alternate discharge points.

Recovery of any impacts to the Pittsburgh Redbeds or overlying strata (strata situated more than 400 feet above the mine) is expected to take place quickly after the longwall face passes beneath, except, perhaps, at shallow perched horizons that discharge to hillside springs or seeps. Some of those perched horizons in the laterally unconstrained zone may undergo a shift in flow paths, causing the discharge point to move.

In the dilated subsidence zone, occupied by the Saltsburg-Buffalo-Mahoning Sandstone sequence and constituting an aquifer that is commonly utilized for well supplies in the area, the increase in storage induced by subsidence will cause initial drops in water level, but gradual recovery or partial recovery during mining is expected to occur, as vertical and lateral recharge is expected to exceed the rate of downward leakage from that interval. Post-mining, recovery will occur after the portal entries are sealed and pumping is terminated.

In the fractured zone extending from the mine up to near the base of the Mahoning Sandstone, recovery will not significantly occur until after mining has been completed and pumping is terminated. After the slope and shaft entries are fully sealed to prevent outflow through those conduits (as is planned), slow leakage of infiltrating water from overlying zones will eventually re-saturate this fractured, permeability-enhanced strata. The potentiometric surface will likely be generally similar to that which existed before mining.

Under the original approved mining plan, the Leer Mine was expected to become fully inundated, with no gravity discharge. Because of this, the mine pool was expected to increase to 1,320 feet, creating the potential for unconfined seepage. The permit was modified in

Revision No. 18 to include a long-term artesian discharge via a wet seal at 1,180 feet. In Revision No. 21, the discharge concept was modified to change the location and elevation of the planned artesian discharge. The water to be discharged at the elevation of the dewatering borehole is expected to be of good quality, with circumneutral pH and total iron concentrations that can readily settle without the use of chemical treatment. Therefore, Revision No. 21 will not create a perpetual discharge of water requiring treatment to meet water quality standards. Moreover, the planned artesian discharge will alleviate potential seepage along Three Fork Creek and will allow for centralized management of the effluent from the Leer Mine.

17.2 REFUSE DISPOSAL AND WATER MANAGEMENT

Refuse Disposal

The Leer Slurry Impoundment (MSHA ID No. WV03-09191-01) is classified as a high hazard potential structure that provides for the disposal of about 38 million cubic yards of coarse coal refuse (CCR) and 17 million cubic yards of fine coal refuse (FCR) over the anticipated life of the Leer Mine. The Leer Mine has been producing coal from the Lower Kittanning Seam since 2013 and is projected to produce from the northern extension beginning in May, 2022. Refuse from both areas will be placed in the Leer Slurry Impoundment. The initial impoundment plan, prepared by Geo/Environmental Associates (G/A), provided for nine stages of refuse disposal construction.

MSHA's Mine Waste and Geotechnical Engineering Division (MWGED) recommended approval of the plan only through Stage 4A (crest elevation remaining at 1,420 feet). The first two stages were centerline and downstream construction. Stages 3 and 4 were modified upstream construction that included a large downstream buttress fill which would raise the dam to a crest elevation of 1,460 feet. In February 2014, G/A submitted a revised plan proposing to enlarge the facility with a total of eight stages beyond Stage 4. The same year, MWGED initiated more rigorous recommendations for short-term slope stability design for upstream-constructed stages, based on current and prudent engineering practice. MWGED recommended that this plan not be approved until satisfactory stability analyses were provided that considered short-term conditions and appropriate FCR strengths under staged loading for each upstream stage. Stage 4 was approved for completion to its final 1,460-foot crest elevation (Stage 4B) on December 8, 2015.

To comply with the new upstream stability analysis recommendation, Arch began submitting each stage separately to MSHA for approval, from Stage 5 onward. Each stage has specific

FCR strength requirements determined by upstream stability analyses and confirmed by performing geotechnical testing and piezometer installations in the completed pushout. Schnabel Engineering (Schnabel) used this information to verify the upstream stability as the stage is raised. The design crest elevations for Stages 5 and 6 are 1,500 and 1,540 feet, respectively. The stages also include construction of a 3,500 feet extension of the dam on the north and east sides of the pool area, creating a 3-sided impounding structure as the crest is raised above the existing topography on the north and east sides. These stages use a principal spillway consisting of a short 36-inch diameter riser and a 36-inch diameter conveyance pipe installed in the left (south) main dam abutment. Arch abandons the previous stage's spillway pipe by grouting once the subsequent stage reaches its design crest elevation.

Stage 7, which is currently under construction, will be a 40-feet high upstream-constructed raise to elevation 1,580 feet, with a 36-inch diameter principal spillway in the left abutment, similar to Stage 6. The only significant change will be extensions of the initial pushouts to at least 50 feet beyond the anticipated toe of the Stage 7 upstream slope. The resulting bench at the embankment toe will be submerged under the FCR slurry as the pool rises. This measure addresses an ongoing surplus of CCR volume to be disposed relative to in-pool FCR volume, and also enhances upstream slope stability. MWGED recommended approval of Stage 7 on February 28, 2019.

As of July 2021 (the end of the last annual reporting period to MSHA), Stage 6B (minimum crest elevation 1,540 feet) was complete and the Stage 7B crest raise to elevation 1,580 feet was complete for most of the north and east embankment extensions. The main dam embankment (western crest) elevation remained at approximately 1,542 feet and the maximum pool elevation was 1503 feet.

Per a December 2018 modification approved by the MSHA, Arch placed CCR fill up to 80 feet thick in the pool area between the north and east embankments and an island of higher natural ground in the pool area. This fill slopes gently from elevation 1,520 feet at the north and east embankment toe to an elevation of 1,500 feet where it abuts the island 200 to 500 feet southwest of the toe. Most, or all, of the shallow FCR accumulated in this area was displaced as the CCR fill was advanced. This fill is the foundation of the upstream-constructed Stage 7 and a portion of the Stage 8 raise of the north and east embankments.

Stage 8 will be similar to previously approved Stage 7 and will raise the dam crest 40 feet to an elevation of 1,620 feet. The Stage 8A raise will use upstream construction on settled FCR- which will be at an estimated elevation of 1,510 to 1,520 feet when construction begins. At the

time of WEIR's visit, slurry elevation was at an elevation of 1,542 feet. Approximately 1,700 linear feet of Stage 8 A at the north and east embankments will be founded on the previously described CCR fill and natural ground island in the pool area rather than FCR. Previous pushouts at the impoundment have typically displaced about 40 to 50 feet of FCR without any reports of pushout instability. As in Stage 7, Arch will extend the initial pushout a minimum of 50 feet beyond the intended toe of the Stage 8A upstream slope. This excess portion of the pushout will be submerged as the ponded FCR pool rises. The completed Stage 8A will result in an upstream-widened crest at elevation 1,580 feet. Stage 8B will then raise the crest to 1,620 feet, with 2.5 horizontal to 1 vertical (2.5H:1V) slopes upstream and 2H:1V slopes downstream. Stage 8 was approved by the MSHA on July 20, 2020.

Beyond Stage 8, Arch plans to extend the Leer Slurry Impoundment through Stage 10 with a crest elevation of 1,680 feet and spillway at an elevation of 1,671 feet, which is projected to be attained in 2031. Coarse refuse storage beyond 2031 is planned for Rocky Branch, with an initial stage constructed an elevation of 1,360 feet projected for completion in 2029. The ultimate Rocky Branch crest elevation is projected at 1,620 feet. If needed, the coarse refuse at the Leer Slurry Impoundment could cover the fine refuse material and raise the top of the coarse refuse to an elevation of 1,780 feet. Total cumulative FCR and CCR storage through the LOM Plan is estimated at 94.2 million tons. If required, the Rocky Branch site could store an additional 62.0 million tons of FCR and CCR.

Water Management

The Leer Mine created two separate temporary fills with culverts utilized for stream diversions. An unnamed tributary of Rocky Branch was diverted below Valley Fill No. 1 utilizing a temporary 7-feet diameter culvert below Valley Fill No. 1 under the Preparation Plant Site Pad. Rocky Branch was diverted utilizing a temporary 10-feet diameter culvert under the downstream portion of the Preparation Plant Site Pad and temporary 9-foot diameter culvert under the upstream portion of the Preparation Plant Site Pad. All temporary culverts were designed to safely convey a 100-year, 24-hour precipitation event.

Water monitoring and management at the Leer Mine consists of several pumping, camera, and treatment systems. Cameras and lights have been installed at strategic locations to allow for visual monitoring of chemical tanks, ponds, and outlets 24 hours a day.

Automatic treatment system for chemical applications at the impoundment ponds consists of turbidity probes, controller, and three pumps for each chemical used. The automatic treatment system for chemical applications of preparation plant ponds consists of turbidity probe, pH

probes, controller, and two pumps for chemicals used in treatment. Treatment tanks are linked to controllers to provide levels and alerts. Email alerts are sent to environmental personnel if any system reading is out of the desired range.

The pumping system at the impoundment ponds allows recirculation between ponds, or diversion to the preparation plant for water used in processing. The preparation plant ponds pumping system allows recirculation between ponds, or diversion to the load out or the preparation plant. Pumping is monitored to track usage as well as recycled water at the operation. The monitoring is tracked by flow meters and pump hours.

Water outlets are sampled in accordance with the approved NPDES permit.

Arch has a work practice that outlines the procedures for properly obtaining field measurements (e.g., pH, flow, etc.) and collecting representative water samples at the Leer Mine permitted property. The procedures described in the work practice pertain to water sampling at the outfalls/outlets and stream monitoring locations. The sampling frequency, outlets/outfalls, stream monitoring locations and associated parameters are summarized in the Leer Mine permits, as well as Arch's Water Discharge Permit Compliance Environmental Operating Procedure (EOP). This work practice is intended to improve overall compliance by providing a comprehensive summary of applicable water quality monitoring requirements in the permit, the WV/NPDES rules for coal mining facilities at Title 47, Series 30 (47CSR30), and the EPA regulations under 40 CFR Part 136.

The laboratories have internal quality control and quality assurance protocols that are followed before delivering sample results to the Arch Engineering Department. The Engineering Department then reviews the sample results once again as a second check for quality control and quality assurance before the results are published.

17.3 PERMITS AND BONDING

Coal mines in West Virginia are required to file applications for and receive approval of mining permits issued by the WVDEP to conduct surface disturbance and mining activities. The Leer Mine has been issued mining permits and associated NPDES permits by the WVDEP as shown in Table 17.3-1 as follows:

Table 17.3-1 Leer Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
U-2004-06, Revision No. 24	152.82	9/11/2020	WV1017764
O-2017-06, IBR No. 4	274.89	6/3/2020	WV1017764
	427.71		

Permit U-2004-06 includes the areas for the preparation plant, underground mine and associated support facilities and infrastructure. Permit O-2017-06 includes the area for the slurry cell and associated drainage structures. The associated NPDES permit is required to allow discharges of water from the permit areas and require submittal of bi-monthly water samples to ensure the discharges are within allowable water quality standards.

The majority of the Leer Mine LOM Plan area is permitted. The permit application for the first two longwall districts of the northern extension of the Leer Mine was submitted on May 3, 2021 and is currently being reviewed by the regulatory agencies. The groundwater inventories and baseline water quality surveys for those areas have been completed. The groundwater inventories and baseline water quality surveys cost approximately $60,000. Future permit revisions will be needed to add underground mining area and associated surface area for bleeder shaft sites.

The Leer Mine has a good compliance record without a history of significant fines or violations. The last violation for U-2004-06 was on June 4, 2015, with a fine of $700 and the last violation for O-2017-06 was on October 9, 2013, with no fine assessed. As an indicator of the Leer Mine's attention to environmental compliance, Leer was presented the Good Neighbor Award from the Office of Surface Mining Reclamation & Enforcement on October 21, 2019.

The current permit numbers, bond amounts and reclamation liability for each permit is shown in Table 17.3-2 as follows:

Table 17.3-2 Leer Mine Permitted Area, Reclamation Liability and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [1] ($000)	Bond No.	Bond Amount ($000)
U-2004-06	152.82	10,762	SUR0044268	7,424
O-2017-06	274.89	5,867	1066186	1,155
	427.71	16,629		8,579

[1] Represents the undiscounted cash flows to satisfy reclamation as of July 2020

17.4 LOCAL STAKEHOLDERS

As indicated in Section 13.5, Arch currently employs approximately 500 personnel at the Leer Mine and is projected to have a maximum employment of 508 personnel during the Leer Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

The Leer Mine is located in a rural and fairly isolated area of West Virginia. Reportedly there have been no social or community impact issues relative to the Leer Mine for several years. Arch received the Greenlands Award from the West Virginia Coal Association for developing, in 2011, the Tygart Valley Community Advisory Panel, which is a non-profit, volunteer entity serving as a forum for open discussion between representatives of the Leer Mine and the residents of the Tygart Valley Area.

17.5 MINE CLOSURE PLANS

The construction of the Leer Mine required the removal of an estimated 2.2 million cubic yards (swelled) of material to create an adequate working surface for the valley fill, road fill, underground mine face-up, slope, shaft, haul roads, access roads, load-out facility, preparation plant facility, storage, coal stockpiles, and truck scales. Upon mine closure, selected areas will be reclaimed to near AOC configuration. Other areas will be left in-place as per the approved alternate post-mining land use requests. Regrading and backfilling activities will commence within 180 days after the mining operations are complete.

There are six openings to the surface from the Leer Mine. These openings consist of the slope, dual intake, and elevator shaft, return shaft, two bleeder shafts (District 5 and Sharp), and the Hardesty intake shaft. Once mining operations terminate, the shafts will be sealed by filling with earth, rock, and rubble from the coal seam to the surface, after which an 8-inch-thick concrete cap will be poured at the surface, prior to backfilling, regrading, and seeding. The slope will be sealed by building a 25 feet long wet seal at the portal, prior to backfilling, regrading, and seeding.

Upon completion of mining, mine soil material will be utilized to return selected areas of the site to AOC. The mine soil material will include topsoil, subsoil, and mixed overburden material that was removed during the construction of the access roads, underground mine site, and preparation plant site. Upon completion of mining operations and regrading, the mine soil

will be redistributed over the selected areas. Mine soil that served as a base for coal stockpiles in the preparation plant area will be tested to determine if supplemental liming is necessary prior to blending this material with the other mine soil onsite. After the permit area has been graded, soil analysis will be performed to determine the quantity of agricultural limestone, or an equivalent supplement, and fertilizer necessary to achieve the post-mining land use. A soil analysis will be performed prior to seeding for each phase of mine reclamation.

The primary pre-mining land use for Permits No. O-2017-06 and U-2004-06 consisted of forestland with a secondary land use of hayland or pasture. The approved post-mining land use for both permits is forestland. The minimum standard for woody plants is 70 percent ground cover of legumes and perennial grasses, and 450 trees (including volunteer tree species) and/or planted shrubs per acre for the growing season of the last year of the responsibility period.

The current permit number, permitted surface area, end of mine reclamation liability estimated by Arch, bond number, and bond amount, is shown in Table 17.3-2. The total bond amount of $8.6 million is based on the mine closure reclamation liability cost estimate as of July 1, 2020, which projected the majority of the reclamation work to take place from 2034 through 2039.

The WVDEP utilizes a bond matrix that determines the rate per acre based upon the activity that the land is to be used for. The U-2004-06 permit takes into account the preparation plant and underground mining areas. The O-2017-06 permit takes into account the refuse impoundment.

17.6 ENVIRONMENTAL COMPLIANCE, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS ISSUES

Permit No. U-2004-06 has only had two permit violations, listed on the WVDEP website, as of October 12, 2020. The first citation was issued for exceeding total aluminum content on August 29, 2013, and was terminated that day. The second violation was issued on June 4, 2015, for completion of developmental mining under protected structures within the 30-degree angle of draw before a pre-subsidence survey had been completed and approved by the WVDEP or before the company had requested and been granted a postponement and/or exemption. The violation was terminated through Revision No. 12 where the company requested and was granted a postponement/exemption for performing pre-subsidence surveys for areas of developmental mining (less than or equal to 60 percent extraction).

There were four violations issued from October 21, 2011, through October 9, 2013, related to Permit No. O-2017-06. Three of the violations were terminated and the fourth violation, issued on October 9, 2013, was withdrawn for being improperly issued. The violation on October 21, 2011, was issued for water exceeding effluent limitations and was terminated that day. The violation on May 16, 2012, was issued for a pipeline that discharged muddy water that impacted the water in the receiving stream and was terminated that day. The violation on January 22, 2013, was issued for a line to pump water from the slurry cell to a pond was not included in the NPDES permit and was terminated on July 1, 2013.

The number of environmental violations issued is low for a coal mining operation the size of the Leer Mine.

There are some residents in the general area that are members of a local watershed group, *Save the Tygart Watershed Association*, that on occasion, in conjunction with the Sierra Club, have appealed permit decisions by the WVDEP. The objections historically are primarily related to unsubstantiated concerns relating to potential water discharges creating material damage to the hydrologic balance within the permit area and Three Fork Creek, upon which the operation is situated. Three Fork Creek is a Total Maximum Daily Load (TMDL) watershed previously impacted by historic mining operations prior to existence of the facility. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant.

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts appear to be adequate and reasonable in order to obtain approvals necessary relative to the execution of the Leer Mine LOM Plan.

17.7 LOCAL PROCUREMENT AND HIRING COMMITMENTS

While not a commitment, the Leer Mine trains and hires five to six applicants from the graduating class of the local high school each year.

18.0 CAPITAL AND OPERATING COSTS

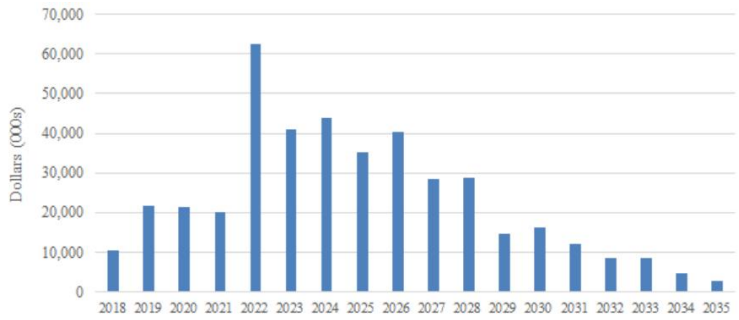
Arch provided historical operating costs and capital expenditures for the Leer Mine, which were an adequate check and basis for the LOM Plan cost projections. The operating costs and capital expenditures are included in the financial statements that are audited annually by Ernst & Young LLP for Arch's 10-K reporting to the SEC. The auditing performed by Ernst & Young, LLP is conducted in accordance with the standards of the Public Company Accounting Oversight Board.

18.1 CAPITAL EXPENDITURES

The Leer Mine will require capital to be expended each year for infrastructure additions/extensions, as well as for mining equipment rebuilds/replacements to continue to produce coal at currently projected annual levels of production. Arch has invested $275 million in the Leer Mine, since inception. These costs ($275 million) are considered "Sunk Costs" and as economic returns in this economic analysis are presented only on a forward-looking basis, Sunk Costs are not included in the economic return of the project, as estimated in this study.

The projected capital expenditures are categorized according to intake, return and bleeder shafts and fans, creek restoration, development capital (advancement items - belt, power, rail, and waterline, mining equipment, and gas well plugging), refuse expansion, fine coal recovery, and Three Forks crossing. Actual capital expenditures for 2018 through 2020 and projected capital expenditures, in 2021 dollars, for 2021 through 2036, are shown on Figure 18.1-2.

Figure 18.1-2 Historical and Projected LOM Plan Capital Expenditures



Note: 2018 through 2020 actual/ 2021 through 2035 projected LOM Plan includes 10 percent contingency)

The 2022 capital expenditures include $23 million for a belt press addition to the preparation plant, which is estimated to have a 20-month payback at projected coal sales prices.

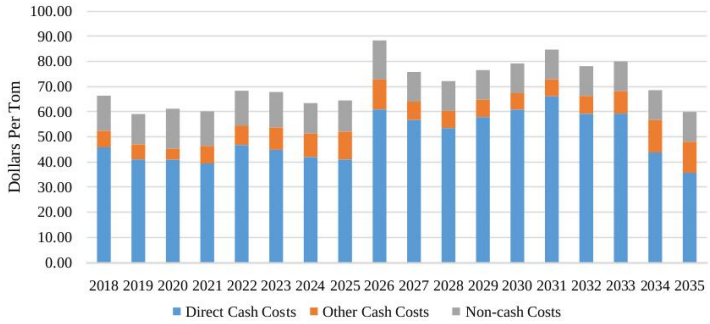
Arch began development of the Leer Mine in 2011 and commenced longwall mining in 2013. Mine management has had several years of experience estimating capital expenditures for longwall mining and the risk of inaccurate estimates is low. The LOM Plan projected average capital cost of $6.99 per ton is $2.44 per ton higher than the four-year historical average of $4.55 per ton, as a result of equipment and infrastructure requirements. Capital expenditures estimates per annual ton are estimated to have an accuracy within +/- 25.0 percent.

Contingency costs account for undeveloped scope and insufficient data. Contingency for required major projects and mining equipment is estimated at 10 percent and is intended to cover unallocated costs from lack of detailing in scope items. It is a compilation of aggregate risk from estimated cost areas.

18.2 OPERATING COSTS AND RISKS

Operating costs are projected based on historical operating costs and adjusted based on projected changes in staffing, hours worked, production, and productivity for mining areas in the LOM Plan. The Leer Mine actual and the Leer Mine LOM Plan projected operating costs in dollars and dollars per ton sold, are shown on Figure 18.2-1.

Figure 18.2-1 Leer Mine Historical and LOM Plan Operating Costs



Descriptions or explanations of the operating costs considered in the LOM Plan are as follows:

Direct Cash Cost:

- Labor cost, which includes wages and benefits for hourly and salary personnel at the mine and preparation plant.
- Contract mining, which includes payments for third party companies providing mining labor, although not projected in the LOM Plan.
- Maintenance and repair, which are expenses related to upkeep of mining equipment and associated infrastructure.
- Tires and Tubes, which are expenses primarily related to rubber tired mobile equipment.
- Operating supplies, which are various items used for mine operations and the preparation plant.
- Drilling and Roof Support, which are expenses related to installation of roof bolts, timbers and crib material.
- Explosives, which are expenses related to blasting rock material when mining equipment becomes stuck between the roof and floor or to create additional cavity height for ventilation overcasts or belt conveyor drives.
- Utilities, which are expenses related primarily to purchase of power to operate electrical equipment in the mine and preparation plant, telephone and data lines, water, and garbage services.
- Fuels and lubes, which are expenses related to diesel fuel, gasoline, motor oil and grease.
- Equipment leases and rent, which are expenses related to copier machines, roller for the refuse area and occasionally rental of a telehandler.
- Taxes and insurance are expenses related to sales taxes on purchased goods and services and to property and liability insurance for risk management purposes.
- Miscellaneous/contract services, which include items such as security services and fines and penalties.
- Capitalized costs, which primarily include longwall items that are replaced or rebuilt between longwall panels that are amortized over the life of the longwall panel.
- Coal Inventory change, which represents the difference in value of the coal and parts and supplies inventory between one accounting period and the next period.

Other Cash Costs:

- Black Lung excise tax, OSM and West Virginia Reclamation tax, and West Virginia Severance tax
- Royalties are expenses paid to landowners that lease property to the Leer Mine.

Non-Cash Costs:

- Reclamation change, Depreciation and Development, and Depletion

The LOM Plan projected cost of sales of $72.49 per ton is $10.51 per ton higher than the three-year historical average of $61.98 per ton. With the long history of cost of sales, no contingency is included, although the accuracy of the LOM Plan projected cost of sales should be considered to be within 13 percent of the historical average.

Capital and Operating Cost Estimation Risk

The Leer Mine has been in operation since 2011 and has had a relatively long period relative to experience with capital and operating costs. Since the mining operation will continue in the same coal seam and mined in the same manner as historically, there is little risk associated with the specific engineering estimation methods used to arrive at projected capital and operating costs. An assessment of accuracy of estimation methods is reflected in the sensitivity analysis in Section 19.3.

For purposes of the Preliminary Feasibility Study completed relative to the Leer Mine LOM Plan, capital costs are estimated to an accuracy of +/- 15 percent with a contingency of 10 percent and operating costs are estimated with an accuracy of +/- 13 percent with no contingency.

19.0 ECONOMIC ANALYSIS

19.1 ASSUMPTIONS, PARAMETERS, AND METHODS

WEIR prepared a Preliminary Feasibility Study financial model in order to assess the economic viability of the Leer Mine LOM Plan. Specifically, plans were evaluated using discounted cash flow analysis, which consists of annual revenue projections for the Leer Mine LOM Plan. Cash outflows such as capital, including preproduction costs, sustaining capital costs, operating costs, transportation costs, and taxes are subtracted from the inflows to produce the annual cash flow projections. Cash flows are recognized to occur at the end of each period. There is no adjustment for inflation in the financial model, all cash flows are in 2021 dollars. WEIR's study is conducted on an un-levered basis, excluding costs associated with any debt servicing requirements.

To reflect the time value of money, annual net cash flow projections are discounted back to the project valuation date, using a discount rate of 10 percent. The discount rate appropriate to a specific project depends on many factors, including the type of commodity and the level of project risks, such as market risk, technical risk, and political risk. The discounted present values of the cash flows are summed to arrive at the project's NPV.

Projected cash flows do not include allowance of any potential salvage value. Additionally, capital previously expended (sunk cost) is not included in the assessment of economic returns.

Arch has indicated that based on accrued Net Operating Losses (NOLs), Arch does not anticipate necessary income tax payments relative to income from Leer Mine. Royalties are forecasted based on mineral lease rates and anticipated mine plan progression through various lease boundaries within the Leer Mine resource area.

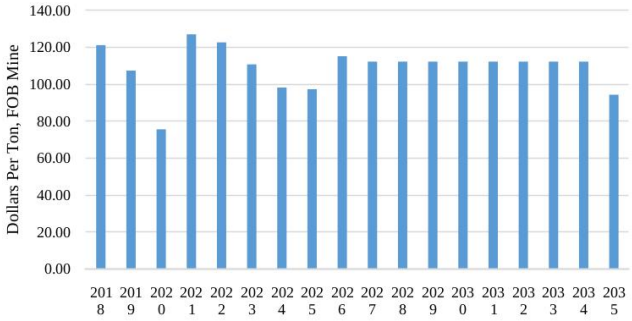
In addition to NPV, the Internal Rate of Return (IRR) is also calculated. The IRR is defined as the discount rate that results in an NPV equal to zero. Payback Period is calculated as the time required to achieve positive cumulative cash flow for the project at a 10 percent discount rate. As the Leer Mine is ongoing with no initial investment required (i.e. already sunk cost), payback period is less than one year.

The Preliminary Feasibility Study financial model developed for use in this TRS is meant to evaluate the prospects of economic extraction of coal within the Leer Mine resource area. This

economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM plan was outside of the scope of this engagement.

The actual and LOM Plan coal sales price forecasts used to estimate revenue are shown on Figure 19.1-1.

Figure 19.1-1 Coal Sales Price Forecast

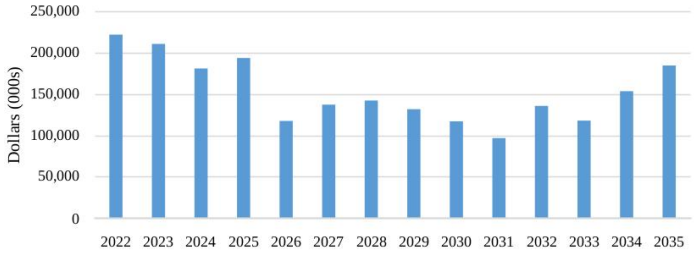


The projected coal sales price in the Preliminary Feasibility Study is based on a High Volatile A benchmark for HCC of $167.50 per metric tonne. Once converted to short tons, adjusted for transportation and the inclusion of middling coal sales, the estimated LOM Plan FOB Mine price is $110.18 per ton.

19.2 ECONOMIC ANALYSIS AND ANNUAL CASH FLOW FORECAST

The annual cash flow for the Leer Mine LOM Plan is shown on Figure 19.2-1 as follows:

Table 19.2-1 Annual Cash Flow Forecast



The Leer Mine LOM Plan has an after-tax NPV of $1.25 billion, at the base case discount rate of 10 percent (Table 19.2-2). As the Leer Mine is ongoing with no initial investment required (i.e. already sunk cost), the IRR indicates that the project NPV is infinite. Cumulative (undiscounted) cash flow over the LOM Plan is positive, at $2.13 billion. The Return on Investment (ROI), at the 10 percent discount rate, is 419 percent.

The after-tax NPV, IRR, cumulative cash flow and ROI are summarized in Table 19.2-2 as follows:

Table 19.2-2 After-Tax NPV, IRR Cumulative Cash Flow, and ROI

	LOM Plan
NPV ($000)	1,251,682
IRR (%)	Infinite
Cumulative Cash Flow ($000)	2,126,535
Return on Investment (%)	419

Table 19.2-3 presents key operational statistics for the LOM Plan on an after-tax basis. Over the LOM Plan, the average cost of sales is $72.49 per clean ton sold. Operating costs include direct cash costs, other cash costs, and non-cash costs.

Table 19.2-3 Key Operating Statistics

	LOM Plan
ROM Tons Produced (000s)	125,207
Clean Tons Produced (000s)	44,195
Preparation Plant Yield (%)	35.3
Marketable Tons Sold (000s)	44,408
	($ Per Ton)
Coal Sales Realization	110.18
Direct Cash Costs	50.94
Other Cash Costs	9.00
Non-cash Costs	12.55
Total Cost of Sales	72.49
Profit / (Loss)	37.69
EBITDA	50.24
CAPEX	6.99

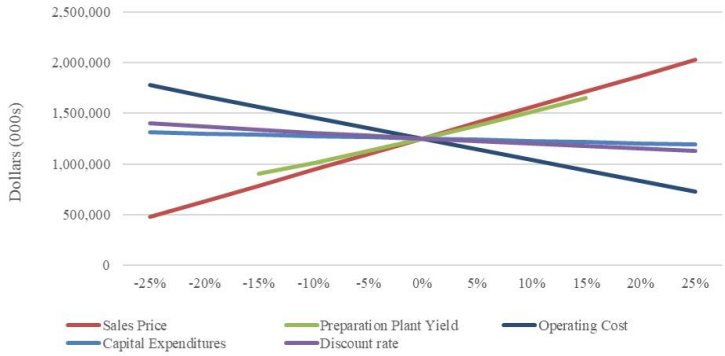
19.3 SENSITIVITY ANALYSIS

A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales prices, preparation plant yield, operating cost, capital expenditures, and the discount rate on the base case after-tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed. The basis for reasonable variability for each element analyzed is summarized as follows:

- Sales Price - Historical coal sales price variability of 16 percent between 2017 and 2020
- Preparation Plant Yield - Variability in preparation plant yield data of up to 17 percent from the 2018 through 2020 average yield
- Operating Cost - Estimated accuracy of 13 percent
- Capital Costs - Assumed accuracy of +/- 25 percent
- Discount Rate - based on range of variability from 7.5 to 12.5 percent

Figure 19.3-1 depicts the results of the NPV sensitivity analysis.

Figure 19.3-1 Net Present Value Sensitivity Analysis



The chart above shows that the project NPV is most sensitive to changes in coal sales price, operating cost, and preparation plant yield. It is less sensitive to changes in discount rate and capital expenditures.

20.0 ADJACENT PROPERTIES

Geological data outside of the Leer Mine Property was provided to WEIR for inclusion in the report analysis. This data went through the same verification procedures WEIR used on all drillhole data within the Leer Mine Property. These data points have been used in the geological structure and quality modeling but are not included in Leer Mine Property summaries of minimum and maximum coal thicknesses and/or standard deviations. Additionally, these data points were not utilized as points of observation relative to applying resource confidence intervals. Utilizing the data outside of the Leer Mine Property assists in trending data through the extremities of the reserve and resource boundaries, which in turn provides a more realistic estimation of tonnage and quality along the borders of the property.

WEIR has discovered no relevant information for any property adjacent to the Leer Mine or its northern extension.

21.0 OTHER RELEVANT DATA AND INFORMATION

Conducting a due diligence investigation relative to the mineral and surface rights of Arch's mining operations was not part of WEIR's scope of work. This TRS is based on Arch controlling, by lease or ownership, or having the ability to acquire the coal reserves and surface lands necessary to support its mine plans.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring mineral rights and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

22.0 INTERPRETATIONS AND CONCLUSIONS

22.1 SUMMARY OF INTERPRETATIONS AND CONCLUSIONS

Interpretation

Among other U.S. underground mines, the Leer Mine is consistently ranked within the top quartile as measured by mine productivity (tons produced per employee hour worked, as reported by MSHA). Additionally, Arch has a long operating history of resource exploration, mine development, and mining operations at the Leer Mine, with extensive exploration data including drillholes, in-mine seam thickness and elevation measurements, and in-mine channel samples supporting the determination of mineral resource and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

The LOM Plan includes projected mining in a limited number of small areas that will be encountered in later years of the LOM Plan where Arch does not have mineral control. Most of these areas are expected to be acquired by Arch, in adequate time, before the areas are scheduled to be mined. However, if those areas cannot be acquired, adjustments could be made to the scheduled LOM Plan to avoid those areas.

Conclusion

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with Regulation S-K 1300 requirements. There are 14.0 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 45.8 million clean recoverable tons of underground mineable reserves within the Leer Mine as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Leer Mine LOM Plan, considering historical mining performance, historical and projected metallurgical coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

22.2 SIGNIFICANT RISKS AND UNCERTAINTIES

Risk, as defined for this study, is a hazard, condition, or event related to geology and reserves, mine operations and planning, environmental issues, health and safety, and general business issues that when taken individually, or in combination, have an adverse impact on Arch’s

development of the Leer Mine. Risks can disrupt operations, adversely affect production and productivity, and result in increased operating cost and/or increased capital expenditures.

In the context of this TRS, the likelihood of a risk is a subjective measure of the probability of the risk occurring, recognizing the magnitude of the risk defined as follows:

Low Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, should not have any material adverse effect on the economic viability of the project.

Moderate Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a detrimental effect on the economic viability of the project.

High Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a seriously adverse effect the economic viability of the project.

Based on a review of available information and discussions with Arch personnel, WEIR identified potential risks associated with the Leer Mine LOM Plan. The risks, WEIR's assessment of risk magnitude, and comments based on WEIR's experience with underground mining operations are summarized in Table 22.2-1 as follows:

Table 22.2-1 Leer Mine Risk Assessment Summary

Area of Risk	WEIR Risk Assessment	Comments
Geology and Coal Reserves	Low	The Lower Kittanning Seam has been extensively mined by the Leer Mine. This mining has not indicated any anomalies in the seam other than normal thinning and thickening, and encountering expected minimal water originating from overlying sandstone strata.
Horizontal Stress	Low	The next longwall districts, 6 and 7, will have longwall panels oriented approximately perpendicular to the current northeast/southwest orientation. Geotechnical studies undertaken do not anticipate problems.
Land Acquisition	Low	To fully develop the Lower Kittanning Seam, it will be necessary to acquire additional mineral control, specifically north of the currently controlled mineral leases. Planning will be necessary to assure that these additional mineral leases are acquired prior to longwall panel development.

Area of Risk	WEIR Risk Assessment	Comments
Methane	Low	Although methane gas is present in the Lower Kittanning Seam, gas liberation experienced to date has been low to undetectable and is expected to remain low, undetectable or at levels that can be safely mitigated during mining. Procedures and continuous gas monitoring are in place to prevent, to the extent possible, methane ignitions and mine fires.
Overburden Stress	Low	The potential for a coal pillar bump or release of stress when mining will be monitored as a part of the normal mining operation. Maximum overburden is approximately 850 feet, and the risk of bumps occurring is minimal, since coal outbursts, as a result of sudden release of energy, are typically associated with depth of cover of 1,500 to plus 2,000 feet.
Qualified Employees	Low to Moderate	In five to eight years, there may be as many as four longwall mines producing in the region. This will increase competition for skilled workers although the Leer Mine typically hires a small number of redhat miners to train each year.
Rail Lines	Low to Moderate	In five to eight years, there may be as many as four longwall mines producing in the region. This may increase competition for rail line capacity. The potential for up to 16 million tons annually with only one CSX rail line in the region may cause congestion and/or increase shipping costs.
Refuse Disposal	Low	Additional refuse disposal area will need to be permitted and developed for use in 2028.
Roof Lithology	Low to Moderate	All underground coal mines have the potential to experience unstable roof conditions. The current Longwall District 5 has minor issues related to a rider seam that merges with the main bench of the Lower Kittanning Seam and results in thicker coal but also some roof instability in the transition zone. This potential risk can be kept in the low range through proper ground control engineering and following approved roof control plans.
Seam Dip	Low	The structure of the Lower Kittanning Seam has a relatively gentle dip, with some localized small areas of relatively steeper dips.
Spontaneous Combustion	Low	The Lower Kittanning Seam has a low potential for spontaneous combustion, and the Leer Mine has not, to date, experienced any loss of production due to spontaneous combustion, since each longwall district is sealed as mining is completed to mitigate the potential of spontaneous combustion. The atmosphere in each sealed area is monitored and made inert with injection of nitrogen gas, if needed.
Water Inflow	Low to Moderate	There have been areas where the Leer Mine has encountered water inflow from the water-bearing sandstone overburden. Normal mine development has and will need to continually address any water encountered through the current and expanded pumping system to adequately handle water encountered in the mine workings.

It is WEIR's opinion that the majority of the risks can be kept low and/or mitigated with proper mine engineering, planning and monitoring of the mining operation.

23.0 RECOMMENDATIONS

The Leer Mine has sufficient geologic exploration data to determine mineral reserves. Future exploration work will be undertaken by Arch to continuously provide geological data primarily for use by mine operations personnel related to effective implementation of the LOM Plan. Future exploration work and mineral property acquisition should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory sample analysis at a 1.40, 1.50 and 1.60 specific gravity to better match the preparation plant specific gravity when processing a metallurgical coal.
- Continue collecting channel samples (include parting).
- Obtain a survey coordinate where a channel sample has been collected.
- Add additional drilling data points in the northern extension of the Leer Mine to increase the confidence of the resource area.

Mineral Property

- Acquire or obtain leases of uncontrolled properties at least two years before the projected mining date.

Permitting and Regulatory Approvals

- Continue permitting and construction efforts relative to a new refuse disposal facility

24.0 REFERENCES

References used in preparation of this TRS are as follows:

- Syd S. Peng and Asmaa Yassien. 2010. *Longwall Chain Pillar Design for ICG's Tygart No. 1 Mine in the Lower Kittanning Seam*
- Monty Heib. 2018. *Report of Diametral Strain Measurement (DSM): Core Holes PD62-15, RM1602, RM1606 (Barbour County, WV)*
- Josuha Bonner. 2019. *Cumulative Hydrologic Impact Assessment Update*
- James Sumner. 2020. *Roof Control Plan Update*
- James Sumner. 2020. *Updated Ventilation Plan*
- Syd S. Peng and William Nan. 2008. *Shield Support Design for Tygart 1 Reserve Area*
- Arch. 2020. *Underground Mine Abandonment Plan*
- Arch. 2020. *Surface and Coal Control drawings*
- Arch. 2020. *Property control Summary Information spreadsheet*
- Arch. 2020. *Clean Coal Handling Facility Drawing 11401-46100*
- Arch. 2020. *Loadout Facility Drawing 11401-47100*
- Arch. 2020. *Raw Coal Handling Facility Drawing 11401-11100*
- Arch. 2020. *Raw Coal Handling Facility Drawing 11401-22100*
- Arch. 2020. *Stockpile Capacities drawing*
- Arch. 2020. *Leer Mine Map as of October 7, 2020*
- Arch. 2020. *Leer Mine LOM Timing Map*
- Arch. 2020. *Leer Mine Infrastructure Map*

Websites Referenced:

- Securities and Exchange Commission - Modernization of Property Disclosures for Mining Registrants - Final Rule Adoption
  https://www.sec.gov/rules/final/2018/33-10570.pdf
- MSHA Data Retrieval Site
  https://www.msha.gov/mine-data-retrieval-system
- WVDEP Permits No. O-2017-06 and U-2004-06
  https://apps.dep.wv.gov/webapp/_dep/securearea/public_query/ePermittingApplicationSearchPage.cfm

25.0 RELIANCE ON INFORMATION PROVIDED BY THE REGISTRANT

In preparing this report, WEIR relied upon data, written reports and statements provided by the registrant. It is WEIR's belief that the underlying assumptions and facts supporting information provided by the registrant are factual and accurate, and WEIR has no reason to believe that any material facts have been withheld or misstated. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by the registrant is reasonable and reliable for use in this report.

The registrant's technical and financial personnel provided information as summarized in Table 25.1 as follows:

Table 25.1 Information Relied Upon From Registrant

Category	Information	Report Section
Legal	Mineral control and surface rights	3
Geotechnical	Pillar design, roof control plans, and rock quality analyses	13.1.1
Hydrogeological	Hydrogeological Analysis including inflow rates, permeability and tranmisivity calculations, and watershed analysis	13.1.2
Marketing	Coal sales price projections	16
Environmental	Permits, bond, and reclamation liability	17
Macroeconomic	Real price growth (coal sales, labor and other cash costs)	18

APPENDIX A - EXHIBITS

Exhibit 15.7-1 Infrastructure Map

Exhibit 96.2

Arch Land, LLC and Arch Resources, Inc. (together "Arch")
Statement of Coal Resources and Reserves for the
Leer South Complex in Accordance with
United States SEC S-K1300 Standards as of December 31, 2021
Barbour, Harrison, and Taylor Counties,
West Virginia, USA

February 2022

Prepared for:
Arch Land, LLC and
Arch Resources, Inc. (together "Arch")
1 City Place Drive, Suite 300
Creve Coeur, MO 63141

Prepared by:
Marshall Miller and Associates, Inc.
582 Industrial Park Road
Bluefield, Virginia 24605
www.mma1.com

Statement of Use and Preparation

This Technical Report Summary (*TRS*) was prepared for the sole use of **Arch Land, LLC and Arch Resources, Inc. (together "Arch")** and its affiliated and subsidiary companies and advisors. Copies or references to information in this report may not be used without the written permission of Arch.

The report provides a statement of coal resources and coal reserves for Arch, as defined under the **United States Securities and Exchange Commission (*SEC*)**.

The statement is based on information provided by Arch and reviewed by various professionals within **Marshall Miller & Associates, Inc. (*MM&A*)**.

MM&A professionals who contributed to the drafting of this report meet the definition of *Qualified Persons* (*QPs*), consistent with the requirements of the SEC.

The information in this TRS related to coal resources and reserves is based on, and fairly represents, information compiled by the QPs. At the time of reporting, MM&A's QPs have sufficient experience relevant to the style of mineralization and type of deposit under consideration and to the activity they are undertaking to qualify as a QP as defined by the SEC.

Marshall Miller & Associates, Inc. (*MM&A*) hereby consents (i) to the use of the information contained in this report dated December 31, 2021, relating to estimates of coal resources and coal reserves controlled by Arch, (ii)) to the use of MM&A's name, any quotation from or summarization of this TRS in Arch's SEC filings, and (iii) to the filing of this TRS as an exhibit to Arch's SEC filings.

This report was prepared by:

Marshall Miller & Associates, Inc.

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Appendix

1 Executive Summary

1.1 Property Description

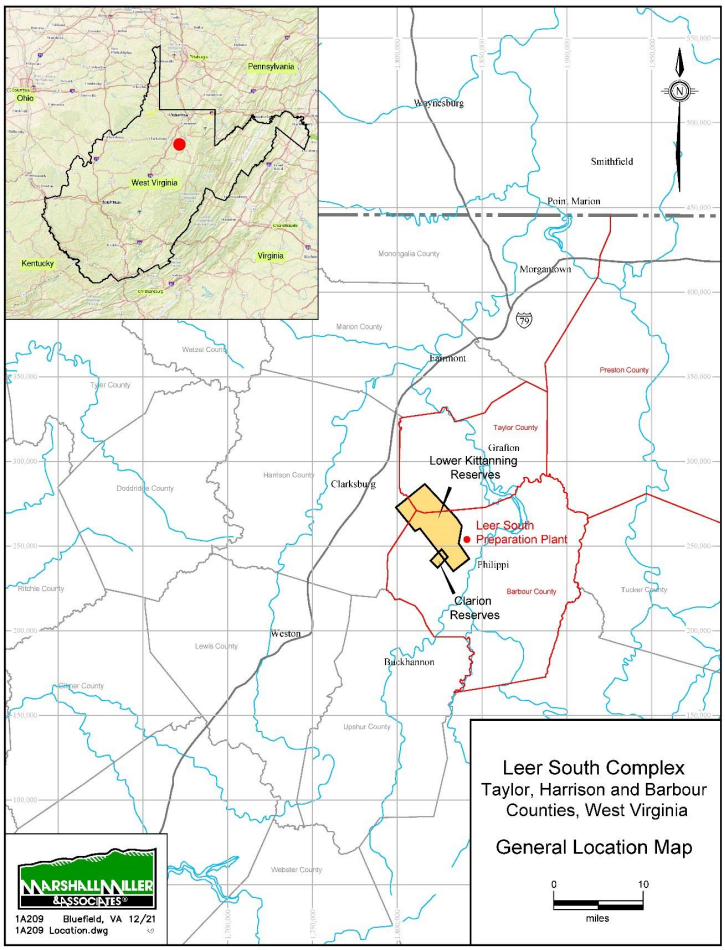
Arch Land, LLC and Arch Resources, Inc. (together "Arch") authorized **Marshall Miller & Associates, Inc. (*MM&A*)** to prepare this Technical Report Summary (*TRS*) of its controlled coal reserves located at the **Leer South Operation (*Leer South*)** in Barbour, Harrison, and Taylor Counties, West Virginia (the *Property*). The report provides a statement of coal resources and coal reserves for Arch, as defined under the **United States Securities and Exchange Commission (*SEC*)** S-K1300 standards.

Coal resources and coal reserves are herein reported in the U.S. system of measurement and are rounded to millions of short tons (*Mt*).

The Leer South Complex is located in Barbour, Harrison, and Taylor Counties in West Virginia. The Leer South mine office is located north of the town of Philippi, the county seat of Barbour County, West Virginia. The nearest cities are Clarksburg and Bridgeport, approximately 17 miles to the northwest. The city of Buckhannon is located 26 miles to the south of the mine. Charleston, the state capital of West Virginia, is located approximately 136 miles southwest of the Property.

For the Lower Kittanning seam, the Property is composed of approximately 25,000 total acres controlled by Arch, approximately 85-percent of which are owned. For the Clarion seam, Arch controls approximately 12,000 total acres, of which approximately 80-percent are leased.

Figure 1-1: Leer South Complex Property Location Map



1.2 Ownership

Since 1974, the Property has been controlled by various mining companies including (in chronological order: **Republic Steel Corporation**, **Old Ben Coal Company**, **Black Diamond Energy Inc.**, **Anker Mining Company (*Anker*)**, **International Coal Group (*ICG*)**, and **Arch Coal Inc. (*Arch*)** in 2011, prior to the current owner, **Arch Resources, Inc.** (name changed in 2020). Mine development in the Clarion seam was started by ICG in 2006, and expansion into the Lower Kittanning seam was begun by Arch in 2018.

1.3 Geology

Operations at the Leer South Complex extract coal from the Lower Kittanning and Clarion seams by continuous miner and longwall mining methods. Strata of economic interest for this TRS belong to the Pennsylvanian-age Allegheny Formation. Due to the high value of these coals, the Lower Kittanning and Clarion seams have been extensively mined in the region. The seam is situated below drainage throughout the Property and is accessed by existing mine slopes/shafts.

1.4 Exploration Status

The Property has been extensively explored, largely by drilling using continuous coring methods and rotary drilling, as well as obtaining coal measurements at mine exposures, ongoing drilling associated with degas activities, and by downhole geophysical methods. The majority of the data was acquired or generated by previous owners of the Property. These sources comprise the primary data used in the evaluation of the coal resources and coal reserves on the Property. MM&A examined the data available for the evaluation and incorporated all pertinent information into this TRS.

Ongoing exploration has been carried out by Arch since acquiring the Property, and Arch-acquired exploration data has been consistent with past drilling activities.

1.5 Operations and Development

Due to its coal reserve and seam characteristics, Leer South operates using longwall (in the Lower Kittanning) methods and continuous mining (in the Clarion seam) methods. Resource and reserve models were therefore generated with both longwall and continuous-mining constraints in mind for Leer South's underground resources. The mines produce coal that is suitable for the high-volatile metallurgical coal markets.

Underground infrastructure has recently been upgraded to accommodate the addition of longwall mining in the Lower Kittanning Seam. Highlights include:

> The belt haulage has been upgraded on the main slope.

> Belt infrastructure has been upgraded to accommodate increased tonnages from all Lower Kittanning sections to the main slope.

> A rail system has been added as a transport method for personnel, equipment, and supplies.

> Three slopes have been driven from the Clarion Seam to the overlying Lower Kittanning Seam.

> A coal storage bunker system has been constructed at the Lower Kittanning Seam interface.

> A ventilation shaft has been added to supply intake air from the Clarion workings and return air to the surface.

> A power upgrade has occurred including a new 138,000-volt substation and tap to the utility.

> A bath house addition constructed adjacent to the existing facility to accommodate the larger workforce.

> A bleeder shaft and fan has been installed to support the initial longwall mining district in the Lower Kittanning seam.

Arch currently operates a coal preparation plant at Leer South. A plant upgrade occurred in 2020 that added a 1000 ton per hour module to the existing 600 tons per hour plant rating. The upgrade included a larger raw stockpile area, a modified unit train loadout, a new refuse belt system and an upgraded impoundment. Processes are typical of those used in the coal industry and are in use at adjacent coal processing plants.

1.6 Mineral Resource

Mineral resources, representing in-situ coal in which a portion of reserves are derived, are presented below. A coal resource estimate, summarized in *Table 1-1*, was prepared as of December 31, 2021, for property controlled by Arch.

Table 1-1: Coal Resources Summary as of December 31, 2021

Seam	Coal Resource (Dry Tons, In Situ, Mt)			
	Measured	Indicated	Inferred	Total
Clarion, Including Lower Floor Rash Material				
Inclusive of Reserve	9.14	0.92	0.00	10.06
Exclusive of Reserve	8.85	4.02	0.00	12.87
Total	**17.99**	**4.94**	**0.00**	**22.94**
Lower Kittanning Rider				
Inclusive of Reserve	4.92	0.48	0.00	5.40
Exclusive of Reserve	0.00	0.00	0.00	0.00
Total	**4.92**	**0.48**	**0.00**	**5.40**
Lower Kittanning				
Inclusive of Reserve	115.70	42.16	0.78	158.63
Exclusive of Reserve	0.00	0.00	0.00	0.00
Total	**115.70**	**42.16**	**0.78**	**158.63**
Grand Total				
Total	**138.60**	**47.58**	**0.78**	**186.96**

Note 1: Coal resources are reported on a dry basis. Surface moisture and inherent moisture are excluded.

1.7 Mineral Reserve

Reserve tonnage estimates provided herein report coal reserves derived from the in-situ resource tons presented in *Table 1-1* which are classified as "Inclusive of Reserve". Proven and probable coal reserves were derived from the defined coal resource considering relevant mining, processing, infrastructure, economic (including estimates of capital, revenue, and cost), marketing, legal, environmental, socio-economic and regulatory factors. The Resource estimate has been used as the basis for this Reserve calculation, which utilizes a reasonable Preliminary Feasibility Study, a Life-of Mine (*LOM*) Mine Plan and practical recovery factors. Production modeling was completed with an effective start date of October 7, 2021. It is important to note that the LOM plan is based on information provided by the company and does not contemplate development of contiguous reserves the company currently controls or could acquire in the future (neither of which have been assessed as part of this TRS), nor does it assume any improvements in: productivity, technological innovations, or operating efficiencies that the company has achieved historically

The Leer South property is unique in that it produces both a metallurgical coking coal product and a middling thermal blend product. As such, reserve tabulations include a breakdown of each respective product. It is of important note that qualities presented in Table 1-3 which correspond which each respective market placement (metallurgical and thermal) are based upon exploration information at prescribed density cutpoints. These quality estimates should be viewed as predictive—actual produced quality will vary based upon a multitude of factors, including, but not limited to: plant operating practices and associated efficiency; plant equipment circuitry; plant feed quality and size distribution; and contractual product specifications.

Factors that would typically preclude conversion of a coal resource to coal reserve, include the following: inferred resource classification; absence of coal quality; poor mine recovery; lack of access; geological encumbrances associated with overlying and underlying strata; seam thinning; structural complication; and insufficient exploration have all been considered. Reserve consideration excludes those portions of the resource area which exhibit the aforementioned-geological and operational encumbrances.

Proven and probable coal reserve were derived from the defined in-situ coal resource considering relevant processing, economic (including technical estimates of capital, revenue, and cost), marketing, legal, environmental, socioeconomic, and regulatory factors. The proven and probable coal reserves on the Property are summarized below in *Table 1-2*.

Table 1-2: Coal Reserves Summary (Dry Basis) as of December 31, 2021

Seam	Demonstrated Coal Reserves (Dry Tons, Washed or Direct Shipped, Mt)								
	By Reliability Category			By Product		By Control Type			
	Proven	Probable	Total	Met ~1.50 Float SG**	Thermal ~1.50 x 1.70 SG**	Owned	Leased	Partially Owned	Partially Leased
Clarion, Including Lower Floor Rash Material	1.25	0.07	1.32	1.12	0.20	0.24	0.65	0.00	0.43
Lower Kittanning Rider	2.18	0.07	2.24	1.97	0.27	0.15	1.81	0.13	0.16
Lower Kittanning	42.71	18.25	60.96	52.68	8.28	53.40	4.12	2.98	0.47
Total	**46.14**	**18.39**	**64.53**	**55.77**	**8.75**	**53.79**	**6.58**	**3.11**	**1.05**
Uncontrolled	4.91	1.52	6.43	5.58	0.86				

*Uncontrolled tons are reported for informational purposes only and are not part of the reserves. Uncontrolled tonnages are contained within small mineral tracts which must be acquired for execution of the life-of-mine plan. As such, uncontrolled tonnages are included in the LOM financial model. See appendix for maps which show details of mineral control.

**Metallurgical tonnages and thermal tonnages (and associated quality) are respectively based upon an approximate 1.50 float and 1.50 x 1.70 specific gravity, as this represented the most consistent coal quality data. In reality, Arch's actual plant operating gravities vary depending upon required product specifications. See "Mineral Processing and Metallurgical Testing" chapter of report for more detailed explanation on derivation of product yields. Exploration coal quality commonly varies from saleable product quality.

Table 1-3: Summary of Quality (dry basis)

Seam	Met (~1.50 Float SG)*			Thermal (~1.5 x 1.70 SG)*		
	Ash	Sulfur	Vol	Ash	Sulfur	BTU
Clarion*	9.6	1.5	33	31.9	3.1	10,088
Lower Kittanning Rider	8.4	1.3	35	31.9	4.3	9,431
Lower Kittanning	8.8	1.3	34	34.8	2.7	8,539
Total	**8.8**	**1.3**	**34**	**34.6**	**2.8**	**8,602**

*Metallurgical tonnages and thermal quality (and associated tonnages) are respectively based upon an approximate 1.50 float and 1.50 x 1.70 specific gravity, as this represented the most consistent coal quality data. See "Mineral Processing and Metallurgical Testing" chapter of report for more detailed explanation on derivation of product yields.

**Qualities presented which correspond with each respective market placement (metallurgical and thermal) are based upon exploration information at prescribed density cutpoints. These quality estimates should be viewed as predictive—actual produced quality will vary based upon a multitude of factors, including, but not limited to: plant operating practices and associated efficiency; plant equipment circuitry; plant feed quality and size distribution; and contractual product specifications

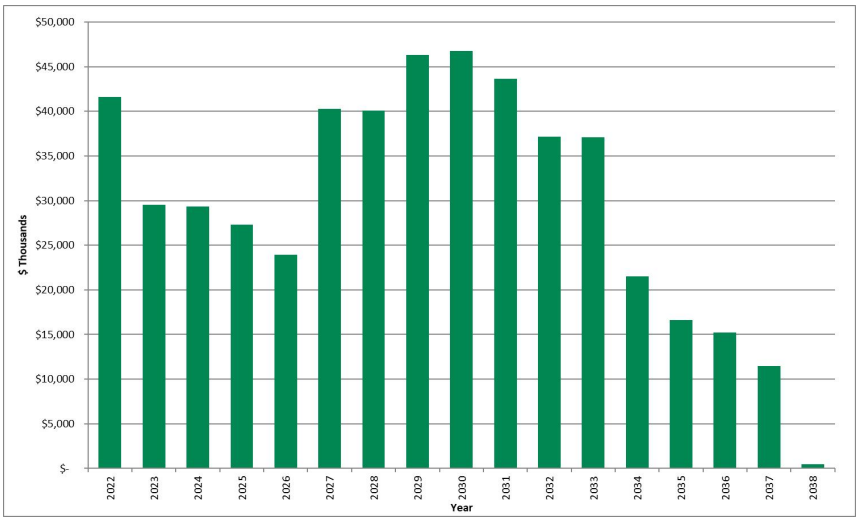
In summary, Arch controls a total of 64.5 Mt (dry basis) of marketable coal reserves, at Leer South, as of December 31, 2021. Of that total, 72 percent are proven, and 28 percent are probable. There are 53.8 Mt of owned coal reserves and 6.6 Mt of leased coal and 4.2 Mt of partial control reserves. Of the 64.5 Mt of marketable reserves, approximately 86-percent are associated with metallurgical coal markets, and all of the Leer South reserves are assigned to existing infrastructure.

1.8 Capital Summary

Arch provided MM&A with a detailed 5-year capital expenditure projection. MM&A reviewed this schedule and deemed it to be appropriate for financial modeling. MM&A extrapolated the provided capital schedule through end of mining operations. Capital forecasting by MM&A assumes that major equipment rebuilds occur over the course of each machine's remaining assumed operating life. Replacement equipment was scheduled based on MM&A's experience and knowledge of mining

equipment and industry standards with respect to the useful life of such equipment. A summary of the estimated capital for the Property is provided in *Figure 1-2* below.

Figure 1-2: CAPEX



1.9 Operating Costs

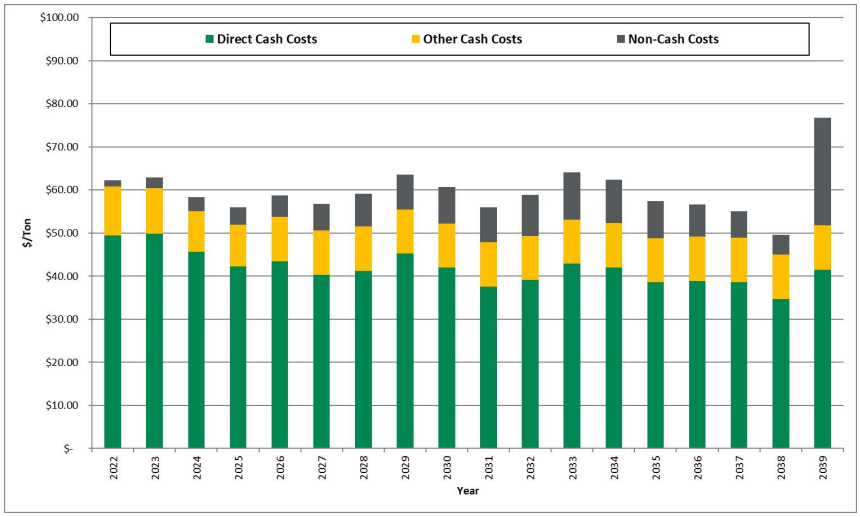
Arch provided historical and projections of operating costs for Leer South for MM&A's review. MM&A used the historical and/or budget cost information as a reference and developed personnel schedules for the mine and support facilities. Hourly labor rates and salaries were based upon information contained in Arch's financial summaries and MM&A's knowledge of regional labor rates. Fringe-benefit costs were developed for vacation and holidays, federal and state unemployment insurance, retirement, workers' compensation and pneumoconiosis, casualty and life insurance, healthcare, and bonuses. A cost factor for mine supplies was developed that relates expenditures to mine advance rates for roof-control costs and other mine-supply costs at underground mines. Other factors were developed for maintenance and repair costs, rentals, mine power, outside services and other direct mining costs.

Operating costs factors were also developed for the coal preparation plant processing, refuse handling, coal loading, property taxes, and insurance and bonding. Appropriate royalty rates were assigned for

production from leased coal lands, and sales taxes were calculated for state severance taxes, the federal black lung excise tax, and federal and state reclamation fees.

A summary of the projected operating costs for the Property is provided in *Figure 1-3*.

Figure 1-3: OPEX



1.10 Economic Evaluation

The pre-feasibility financial model prepared for this TRS was developed to test the economic viability of the coal resource area. The results of this financial model are not intended to represent a bankable feasibility study, required for financing of any current or future mining operations contemplated for the Arch properties, but are intended to establish the economic viability of the estimated coal reserves. Cash flows are simulated on an annual basis based on projected production from the coal reserves. The discounted cash flow analysis presented herein is based on an effective date of January 1, 2022. On an un-levered basis, the NPV of the project cash flow after taxes represents the Enterprise Value of the project. The project cash flow, excluding debt service, is calculated by subtracting direct and indirect operating expenses and capital expenditures from revenue.

Cash flow after tax, but before debt service, generated over the life of the project was discounted to NPV at a 14.67% discount rate, which represents MM&A's estimate of the constant dollar, risk adjusted WACC for likely market participants if the subject reserves were offered for sale. On an un-levered

basis, the NPV of the project cash flows represents the Enterprise Value of the project and amounts to $903 million. The pre-feasibility financial model prepared for the TRS was developed to test the economic viability of each coal resource area. The NPV estimate was made for purposes of confirming the economics for classification of coal reserves and not for purposes of valuing Arch or its Leer South assets. Mine plans were not optimized, and actual results of the operations may be different, but in all cases, the mine production plan assumes the properties are under competent management. Key outputs from the financial model are summarized in the table below.

Table 1-4: Key Operating Statistics[1,3]

	LOM Plan
ROM Tons Produced (x 1,000)	148,193
Clean Tons Produced, Moist Basis (x 1,000)[4]	77,552
Preparation Plant Yield (%)	52%
Coal Sales Realization ($/ton)[2]	$98.59
Direct Cash Costs ($/ton)	$42.05
Other Cash Costs ($/ton)	$10.34
Non-Cash Costs ($/ton)	$6.78
Total Costs of Sales ($/ton)	$59.17
Profit/(Loss)	$39.42
EBITDA	$46.21
CAPEX ($/ton)	$6.55

Note 1: The LOM Economic Model was develop based upon mine faces as of October 3, 2021, whereas reserves were calculated as of December 31, 2021. As such, the economic model includes a small portion of tonnages not included in the reserve estimate. Additionally, the LOM model includes tonnages contained within uncontrolled tracts which are not included in reserve estimates.
Note 2: Realized coal prices are based upon a combination of thermal (middlings) and high-volatile A coking coal products. Realized coal prices incorporate HCC indices, adjustments from metric tons to short tons, adjustments for transportation costs and assumed prices for thermal products.
Note 3: The LOM model and associated economic analysis is intended to prove the economic viability of the subject coal tonnage, allowing controlled tons to be classified as "reserve". The exercise should not be construed to represent a valuation of Arch's holdings. Long term cash flows incorporate forward looking market projections which are expected to vary over time based upon historic volatility of coal markets.
Note 4: Saleable tons for financial modeling purposes are presented on a moist basis whereas reserve tons are presented on a dry basis.

A sensitivity analysis was completed by MM&A to determine the influence of changes to various assumptions in the financial model. Based on the results, the project is most sensitive to assumed sales price, followed by operating costs, and then capital estimates.

1.11 Permitting

Arch has obtained all mining and discharge permits to operate its mine and processing, loadout, and related support facilities. MM&A is unaware of any obvious or current Arch permitting issues that are expected to prevent the issuance of future permits. Leer South, along with all coal producers, is subject

to a level of uncertainty regarding permits due to the **United States Environmental Protection Agency (*EPA*)** involvement with state programs.

1.12 Conclusion and Recommendations

Sufficient data have been obtained through various exploration and sampling programs and mining operations to support the geological interpretations of seam structure and thickness for coal horizons situated on the Leer South Property. The data are of sufficient quantity and reliability to reasonably support the coal resource and coal reserve estimates in this TRS.

The geological data and preliminary feasibility study, which consider mining plans, revenue, and operating and capital cost estimates are sufficient to support the classification of coal reserves provided herein.

This geologic evaluation conducted in conjunction with the preliminary feasibility study concludes that the 64.5 Mt of marketable underground coal reserves identified on the Property are economically mineable under reasonable expectations of market prices for metallurgical coal products, estimated operation costs, and capital expenditures. In order to successfully recover the aforementioned controlled reserves, additional properties must be acquired by Arch. Such properties contain an estimated additional one-million tons of recoverable coal.

2 Introduction

2.1 Registrant and Terms of Reference

This report was prepared for the sole use of **Arch Land, LLC and Arch Resources, Inc. (together "Arch")** and its affiliated and subsidiary companies and advisors. The report provides a statement of coal resources and coal reserves for Arch, as defined under the **United States Securities and Exchange Commission (*SEC*)** SK-1300 standards.

The report provides a statement of coal reserves for Arch. Exploration results and Resource calculations were used as the basis for the mine planning and the preliminary feasibility study completed to determine the extent and viability of the reserve.

Coal resources and coal reserves are herein reported in the U.S. system of measurement and are rounded to millions of short tons.

2.2 Information Sources

The technical report is based on information provided by Arch and reviewed by Michael G. McClure, CPG; and Steven A. Keim, PhD, PE. Additionally, Mr. Timothy J. Myers, PE, of Marshall Miller and

Associates, participated in site visits to the operations and contributed to the development of this report. These gentlemen were assisted by various technical staff of MM&A.

Arch engaged MM&A to conduct a coal reserve evaluation of the Arch coal properties as of December 31, 2021. For the evaluation, the following tasks were to be completed:

> Conduct site visits of the mines and mine infrastructure facilities, most recently in October 2020;

> Process the information supporting the estimation of coal resources and reserves into geological models;

> Develop life-of-reserve mine (*LOM)* plans and financial models;

> Hold discussions with Arch company management; and

> Prepare and issue a TRS providing a statement of coal reserves which would include:

- A description of the mine and facilities.
- A description of the evaluation process.
- An estimation of coal reserves with compliance elements as stated under the SEC S-K 1300 standards.

MM&A reviewed pertinent exploration information provided by Arch, including a robust exploration and quality database. Additionally, mine plans and life-of-mine economic models were provided by Arch and reviewed by MM&A. Arch provided various property maps, permit maps, and additional ancillary data to MM&A for the engagement.

2.3 Personal Inspections

MM&A is very familiar with Leer South, having provided a variety of services in recent years, and the MM&A employees involved in the development this TRS have conducted site inspections, to both surface and underground facilities, on October 8, 2020.

Moreover, between 1998 and 2021, MM&A has had a presence on the Property through its geophysical logging division, GLS, having e-logged nearly 110 exploration holes for Arch and its predecessors. MM&A has also conducted numerous hydrogeological and geotechnical investigations at the subject property.

3 Property Description

3.1 Location

The Leer South Mine Complex is located in Barbour, Harrison, and Taylor Counties, West Virginia (see *Figure 1-1*) approximately 3 miles northwest of Philippi, which is the county seat of Barbour County.

Surface facilities for the mine are located adjacent to US Highway 119. The Leer South mine transports coal to the CSX railroad via the Appalachian and Ohio Railroad (A&O), and from there to Grafton, West Virginia.

The Property is located on the following **United States Geological Survey (*USGS*)** 7.5-Minute Quadrangles: Brownton, Grafton, Philippi, and Rosemont, West Virginia. Current mining projections fall within the Brownton, Philippi, and Rosemont quadrangles.

The coordinate system and datum used for the model of Leer South and subsequent maps were produced in the West Virginia State Plane North system, NAD 27.

3.2 Titles, Claims or Leases

For the Lower Kittanning seam, the Property is composed of approximately 25,000 total acres controlled by Arch, approximately 85-percent of which are owned. For the Clarion seam, Arch controls approximately 12,000 total acres, of which approximately 80-percent of which are leased.

Subject to Arch's exercising its renewal rights thereunder, all the leases expire upon exhaustion of the relevant coal reserves, which is expected to occur in 2039. MM&A has not carried out a separate title verification for the coal property and has not verified leases, deeds, surveys, or other property control instruments pertinent to the subject resources. Arch has represented to MM&A that it controls the mining rights to the reserves as shown on its property maps, and MM&A has accepted these as being a true and accurate depiction of the mineral rights controlled by Arch. The TRS assumes the Property is developed under responsible and experienced management.

3.3 Mineral Rights

Arch supplied property control maps to MM&A related to properties for which mineral and/or surface property are controlled by Arch. While MM&A accepted these representations as being true and accurate, MM&A has no knowledge of past property boundary disputes or other concerns, through past knowledge of the Property, that would signal concern over future mining operations or development potential.

Property control in Appalachia can be intricate. Coal mining properties are typically composed of numerous property tracts which are owned and/or leased from both land-holding companies and private individuals or companies. It is common to encounter severed ownership, with different entities or individuals controlling the surface and mineral rights. Mineral control in the region is typically characterized by leases or ownership of larger tracts of land, with surface control generally comprised of smaller tracts, particularly in developed areas.

Legal mining rights may reflect a combination of fee or mineral ownership and fee or mineral leases of coal lands through various surface and mineral lease agreements. There is also a relatively small

amount of area where the coal is partially owned and/or partially leased on a limited number of individual tracts.

Control of the surface property is necessary to conduct surface mining but is not necessary to conduct underground mining. Given that the Property has had active mining operations dating back to the 1970's, Arch, and its predecessors, have a successful history of obtaining any necessary rights and the associated permits to mine.

3.4 Encumbrances

No Title Encumbrances are known. By assignment, MM&A did not complete a query related to Title Encumbrances.

3.5 Other Risks

There is always risk involved in property control. Arch's land division and legal teams continually examine critical properties and associated deeds and title control in order to minimize the risk. MM&A is not aware of any historical property control challenges related to Leer South's operations.

4 Accessibility, Climate, Local Resources, Infrastructure and Physiography

4.1 Topography, Elevation, and Vegetation

The Leer South mine is located on the Appalachian plateau of northern West Virginia. The topography of the Property consists of rolling terrain with slopes rising from the Tygart River and associated tributaries. The Tygart River Valley extends from Pocahontas County, West Virginia, north through Randolph, Barbour, Taylor and Marion Counties. The Leer South mine is located to the west of the Tygart River northwest of the town of Philippi, West Virginia. The upper elevations consist of sinuous ridgelines of elevations rising up to 1,900 feet.

The terrain drops off from the higher elevations with steep slopes down to Foxgrape Run, Little Hackers Creek, Hackers Creek and Shooks Run to the south. The drainages of Stewart Run, Spaw Lick and Brushy Fork are found to the southwest. Pleasant Creek, Simpson Creek, Camp Run, Stillhouse Run, Bartlett Run and Beards Run are located to the north. There are scattered areas of relatively flat lying pastureland on the river and stream floodplain terraces. Maximum relief of the Property is approximately 900 feet. Elevation ranges from 1,000 feet on Simpson Creek to the north and up to 1,905 feet on a knob located between Stewart Run and the head of Simpson Creek.

The surface of the Leer South mine property consists mostly of unmanaged forestland and pastureland. The forestland consists of typical West Virginia forest species with Oak/Hickory as the dominant forest-type group with a lesser percentage of the Maple/Beech/Birch forest group.

4.2 Access and Transport

The Leer South mine office is located off of US Route 119, near the town of Philippi in Barbour County, West Virginia. The nearest cities are Clarksburg and Bridgeport, West Virginia, approximately 17 miles to the northwest. The city of Buckhannon, West Virginia is located 26 miles to the south of the mine. The property can be accessed from Clarksburg/Bridgeport via West Virginia Route 76 and US Route 50. The property can be accessed from Buckhannon via US Route 119 to Philippi.

The nearest airport to the mine is the North Central West Virginia Airport (*CKB*) which is located in Bridgeport, West Virginia. The North Central West Virginia Airport is 17 miles from the mine office. The Morgantown Municipal Airport (*MGW*) is located 43 miles to the north in Morgantown, West Virginia.

The Leer South mine transports coal to the **CSX Railroad (*CSX*)** via the **Appalachian and Ohio Railroad (*A&O*)**. A&O operates 158 miles of shortline from Cowen, West Virginia to Grafton, West Virginia. CSX operates the Mountain Subdivision from Cumberland, Maryland through Grafton, West Virginia. CSX operates a rail yard at Grafton, West Virginia.

4.3 Climate and Length of Operating Season

The climate of the Leer South mine property is classified as a humid continental climate. This entails hot, humid summers and moderately cold winters. Climate conditions vary greatly in the state of West Virginia due to influence of the rugged topography. Average high temperatures range from 82 to 87 degrees Fahrenheit in the summer with average ranges from 15 to 25 degrees Fahrenheit for the lows in winter. Average yearly rainfall measured in Philippi, West Virginia is 52 inches per year. The Leer South mine operates year-round.

4.4 Infrastructure

The Leer South Complex has sources of water, power, personnel, and supplies readily available for use. Personnel have historically been sourced from the surrounding communities in Barbour, Harrison, and Taylor counties, and have proven to be adequate in numbers to operate the mine. As mining is common in the surrounding areas, the workforce is generally familiar with mining practices, and many are experienced miners. Water is sourced locally from local streams overlying and proximal to Arch's property. The mine also utilizes ground water from an old abandoned mine. Electricity is sourced from **MonPower**, a **First Energy Company**. Additionally, water is sourced from the toe of the refuse impoundment for various uses in the mine and plant. The service industry in the areas surrounding the mine complex has historically provided supplies, equipment repairs and fabrication, etc. The Arch-owned Leer South Preparation Plant services the mine via a slope conveyor system which transports

extracted coal from an underground bunker to the surface facility. The Appalachian and Ohio rail line serves as the main means of transport from the mine.

5 History

5.1 Previous Operation

The area north of Philippi, West Virginia along the Tygart River has had mining in the Lower Kittanning seam since the early 1900's. The **West Virginia Geologic and Economic Survey (*WVGES*)** and the **West Virginia Department of Environmental Protection (*WVDEP*)** show the following companies and mines operating in the area along the Tygart River near the Leer South property:

> Midland Coal and Coke No. 1 Mine (1905)
> Bar-Jay Coal Company, Morral No. 1 and No. 2 Mines (1957)
> Ketchum Coal Company, Mine No. 1 (1964)
> Johnson Coal Company (1974)
> Pittston Coal Group / Badger Coal Company, Mines No. 13 and 14 (1974, 1984)

The Leer South mine property has had mining occur under a number of companies and mine names as listed below:

> Republic Steel Corporation / Kitt Energy Company, Kitt mine (1974 Initial development)
> Republic Steel Corporation / Kitt Energy Company, Kitt mine (1975 – 1982 production)
> Old Ben Coal Company, Kitt mine (1982 – 1987)
> Black Diamond Energy Inc., name changed to Diamond No. 1 Mine (1987 - 1990)
> Anker Group subsidiary Philippi Mining Company / Philippi Development, Inc., name changed to Sentinel Mine (1990)
> Philippi Development, Inc. changed name to Anker West Virginia Mining Company, Sentinel Mine (1998)
> Anker Mining Company, Sentinel Mine production transferred to Upper Kittanning seam (2000)
> Anker Mining Company / Wolf Run Mining Company, Sentinel Mine (2005)
> International Coal Group / Wolf Run Mining Company, Sentinel Mine (Lower Kittanning mining ended 2006)
> International Coal Group / Wolf Run Mining Company, Sentinel Mine (Clarion seam mining begins 2006)

> Arch Coal Inc. / Wolf Run Mining Company, Sentinel Mine (Clarion seam mining, 2011)

> Arch Coal Inc. / Wolf Run Mining Company, Sentinel Mine (Expansion into Lower Kittanning seam 2018)

> Arch Resources, Inc. /Sentinel Mine name changed to Leer South mine (2020) (Mining both Lower Kittanning and Clarion)

A large number of deep and contour strip surface mines occurred in the area in the Pittsburgh and Redstone seams. This mining occurs approximately 800 feet above the Lower Kittanning seam.

5.2 Previous Exploration

Exploration work carried out by previous companies consists of continuous core drilling and e-logging of rotary drill holes. Previous to Arch Coal Inc./Arch Resources Inc. control of the Property there were 289 drill holes drilled within the area of the Leer South Lower Kittanning and Clarion mine plans.

The following lists companies, number of drill holes drilled, laboratories used and dates of drilling.

Table 5-1: Summary of Previous Exploration

Company	No. of Drill Holes	Quality Lab	Years Drilled
Simpson Creek Collieries	1	None	1955
Badger Coal Company	4	None	1965
Island Creek Coal Company	1	Island Creek Co. Lab	1967
Badger Coal Company	3	Badger Coal Co. Lab	1968
Mountaineer Coal Company	3	None	1968
Badger Coal Company	3	Badger Coal Co. Lab	1969
Hillman Coal and Coke Company	4	None	1970
Badger Coal Company	8	Badger Coal Co. Lab	1970
Badger Coal Company	9	Badger Coal Co. Lab	1971
Hillman Coal and Coke Company	2	Unknown lab	1972
Hillman Coal and Coke Company	18	Unknown lab	1973
Republic Steel Corporation	1	None	1973
Tygart West Inc./Hillman Coal Co.	2	Unknown lab	1973
Tygart West Inc. /Hillman Coal Co.	4	Unknown lab	1974
Badger Coal Company	14	Pittston Coal Group Lab	1975
Bethlehem Mines Corporation	1	Bethlehem Mines Corp. Chemical Lab	1975
Badger Coal Company	23	Pittston Coal Group Lab	1976
Badger Coal Company	1	Pittston Coal Group Lab	1977
Consol Energy, Inc.	1	None	1977
Badger Coal Company	6	None	1978
Consol Energy, Inc.	1	None	1978
Republic Steel Corporation	32	Republic Steel Chemical Lab	1978
Petroleum Development Corp.	1	None	1979
Republic Steel Corporation	31	Republic Steel Chemical Lab	1979
Hillman Coal Company	10	Unknown Lab	1980
Republic Steel Corporation	3	Commercial Testing and Engineering Co.	1980
Hillman Coal Company	3	Unknown Lab	1981
Republic Steel Corporation	11	Commercial Testing and Engineering Co.	1981
Republic Steel Corporation	3	None	1982
Kitt Energy Corporation	9	None	1983
Kitt Energy Corporation	1	None	1983
Hillman Coal Company	3	None	1987

Company	No. of Drill Holes	Quality Lab	Years Drilled
Anker Energy Corporation	2	None	1990
Anker Energy Corporation	3	Coal Operators Analytical Lab	1998
Anker Energy Corporation	2	None	1999
Anker Energy Corporation	1	None	2001
Anker Energy Corporation	2	None	2002
Ryanstone Coal Company	3	Standard Laboratories, Inc.	2002
CDX Gas, LLC	5	Unknown Lab	2004
Anker Energy Corporation	1	None	2005
CDX Gas, LLC	6	Unknown Lab	2005
CDX Gas, LLC	10	Unknown Lab	2006
International Coal Group, LLC	21	Coal Operators Analytical Lab	2006
CDX Gas, LLC	6	None	2007
CDX Gas, LLC	8	None	2008
International Coal Group, LLC	2	None	2009

6 Geological Setting, Mineralization and Deposit

6.1 Regional, Local and Property Geology

The strata of the Tygart Valley in Taylor and Barbour Counties, West Virginia consists of Pennsylvanian age sedimentary strata of the Monongahela Group, the Conemaugh Group, and the Allegheny Formation. The gently dipping layered strata consists of shale, sandstone, claystone, fireclay and coal seams. At present, economic sedimentary deposits are limited to coal.

The Monongahela Group includes the Sewickley, Redstone and Pittsburgh coal seams. The Pittsburgh seam has been heavily surface and deep mined at higher elevations in the Tygart region.

The Conemaugh group coal seams include the Elk Lick, Harlem, Bakerstown and Brush Creek coal seams. These seams are generally thin and discontinuous on the Leer South property. No known mining has taken place in the Conemaugh group coal seams in the Leer South mine area.

The Allegheny Formation includes the Upper and Lower Freeport coal seams, Johnstown Limestone, Upper and Lower Kittanning coal seams, the Clarion and Brookville coal seams. The Upper Kittanning, Lower Kittanning and Clarion seams have been deep mined in the Leer South area. All other coal seams of the Allegheny Formation in the area occur in limited areal extent and are of insufficient thickness for mining. The Upper Kittanning coal seam has had limited mining in the area, often hampered by soft floor strata and high sulfur content. Leer South is currently mining the Lower Kittanning seam and the Clarion seam.

6.1.1 Lower Kittanning Seam Distribution

The Lower Kittanning seam has been heavily mined to the east and south of current mining in the Kitt mine. The Leer South Lower Kittanning reserve is situated from Mansfield, West Virginia, in the south and extends north to Rosemont, West Virginia. The reserve extends from US Route 119 on the east

side to Glade Run on the west side of the reserve. The reserve is approximately 9.5 miles in length (northwest to southeast) and approximately 5.9 miles wide, (northeast to southwest).

The Lower Kittanning seam consists primarily of a dual-bench horizon (tagged as 4600) with a thin boney coal or carbonaceous shale parting between the two benches, (typically less than 1 foot in thickness). An overlying Rider seam (tagged as 4650) is present primarily within the southern portion of the mine plan that can add an additional 2.7 feet of coal to the Lower Kittanning seam. Drill holes show the seam thickness within the reserve boundary ranging from 0.0 to 6.6 feet, (10.9 feet including the rider). The Lower Kittanning seam thins to less than 3.0 feet to the west of the Leer South Lower Kittanning mine plan.

6.1.2 Clarion Seam Distribution

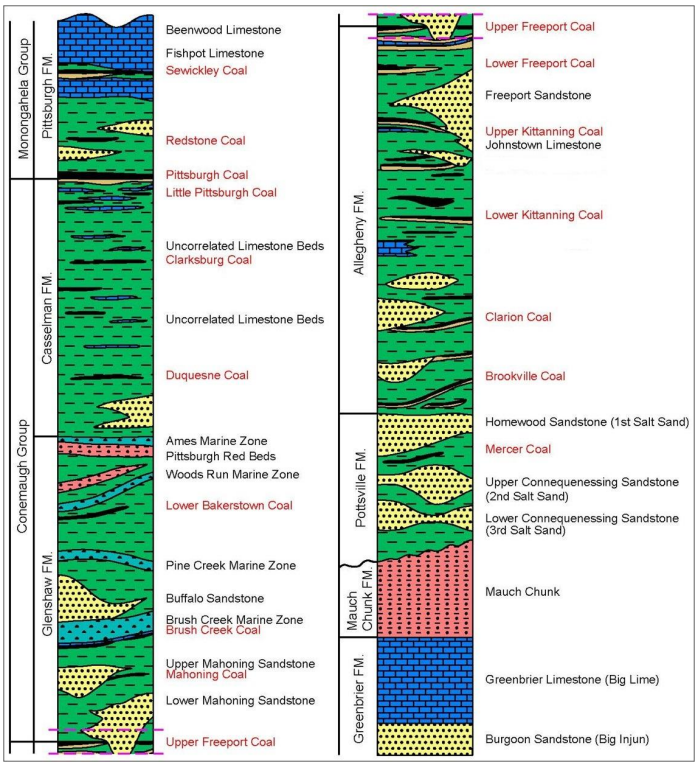
Drill holes show the Clarion seam to be located within an interval of 41 to 132 feet below the Lower Kittanning across the Property; and within the areas where Lower Kittanning longwall and Clarion continuous miner projections are both planned for mining, the interval between the seams ranges from 56 to 74 feet. The Clarion has been mined at Leer South since 2006. The Clarion reserve lies north of Philippi, West Virginia and west of the Tygart River.

The Clarion seam consists of three principal coal horizons (tagged as 4000, 3800 and 3400 benches,) with thin discontinuous shale and boney coal partings. Mining in the Clarion seam typically consists of mining the 4000 bench and portions of the lower benches (3800 and the 3400 benches) which are typically higher-ash, higher-sulfur and lower-yield products. Wherever feasible, mining targets the higher quality upper portion of the Clarion seam.

6.2 Mineralization

The generalized stratigraphic columnar section in *Figure 6-1* demonstrates the vertical relationship of the principal coal seams and rock formations on or adjacent to the Property.

Figure 6-1: Generalized Stratigraphic Column for the Northern Appalachian Basin (not to scale)



6.3 Deposits

The coal produced at Leer South is typically High Volatile (>31% volatile matter) bituminous coal. Due to the historical value of the Lower Kittanning and Clarion seams as high-volatile bituminous coals, both seams have been extensively mined in the region. Multiple coal benches are found within both the Lower Kittanning and Clarion horizons within the projections for the Property. Due to relatively high sulfur and high ash middling material, neighboring producers (including Arch's Leer property) produce two products, including a low-ash coking coal and high-ash, high-sulfur thermal blend product.

6.3.1 Lower Kittanning Seam

The 4650 (Rider) and 4600 (Main seam) benches are splits of the Lower Kittanning horizon present on the Property and within the projected mining areas. Due to variations in the splitting and merging characteristics of these coal beds, two mining configurations are present within the Lower Kittanning horizon.

1. Main seam only (4600 bench), ranging from 0.00 feet to a maximum of 9.00 feet, typically from 4.50 to 5.00 feet within the longwall panel areas. The Lower Kittanning seam consists primarily of a dual-bench horizon (tagged as 4600) with a thin boney coal or carbonaceous shale parting between the two benches, (typically less than 1 foot in thickness). Main seam only mining occurs where the Rider is either not present or is located above the assumed 7.00-foot average cutting height of the longwall shearer.
2. Main seam with overlying Rider seam (4600 + 4650), or Full seam. Mining of the two benches occurs where the Rider is located within the 7.00-foot average cutting height of the longwall shearer. Under this scenario, the parting between the two benches ranges typically from 1.00 to 2.00 feet, and the resulting maximum mining height (assuming that the full extent of the Rider seam is excavated) approaches 10.90 feet.

The Lower Kittanning seam is situated below drainage throughout the Property and is accessible by existing slopes and shafts. Composition of the mine floor varies across the projected mine area, consisting primarily of shale, sandy shale, and occasionally shaley fireclay. The lithologic composition of the immediate roof strata exhibits greater variability due to the presence (or absence) of the Rider seam but consists primarily of dark gray to black shale which coarsens upward to sandy shale. As noted above, the Rider seam can occur within 1-foot of the top of the Main seam where it is included within the mineable section but may occur more than 15 feet above the Main bench.

6.3.2 Clarion Seam

The Clarion seam is present as multiple benches across the Property and within the projected mining areas, identified as follows in descending stratigraphic order: 4000 (uppermost and thickest benches with lowest sulfur content), 3800 (middle bench with intermediate sulfur content, also referred to as the upper leader), and 3400 (lowermost bench typically with highest sulfur content, also referred to as the lower leader or "rash").

The 3800 and 3400 benches exhibit significantly greater variability in thickness than the 4000, and in some locations, are entirely absent. Due to variations in the splitting / merging and quality characteristics of these coal beds, and in conjunction with the minimum continuous miner cutting height (5.50 feet), two mining configurations are present within the Clarion horizon.

Furthermore, due to variations within the database regarding the stratigraphic position of the 3800 and 3400 seam tags, and the manner in which core samples were analyzed, two additional engineering tags

have been applied to the database (*Clarion Upper Floor*, or "CLRUF", and *Clarion Lower Floor*, or "CLRLF") in order to mark the position of the mine floor under two separate mining scenarios as described in *Items 2* and *3* below. (Each of these engineering tags has a thickness of zero.)

1. The 4000 bench only ranges from 1.00 feet to 6.00 feet and is typically 4.00 to 5.50 feet within mine plan areas. It consists primarily of a dual-benched horizon with thin boney coal or carbonaceous shale parting (from 0.15 to 1 foot in thickness) between the two benches. This seam is mined alone where the underlying 3800 and 3400 benches are either absent or are practically beyond the mineable limit of the continuous miner. Wherever the thickness of the 4000 bench is less than 5.50 feet, the CLRUF and CLRLF engineering tags have been inserted below the 4000 Bench at a depth that equates to a minimum mining height of 5.50 feet (refer to *Exhibits 1 and 2* in the *Appendix* of this report).
2. The 4000 + 3800 (upper leader) typical range from 5.70 to 7.00 feet within mine plan areas. The base of this mining scenario is defined by the CLRUF tag (refer to *Map 3* in the *Appendix*.) A shale parting occurs between the two benches, ranging from 0.50 to 1.00 feet in thickness. Immediate floor strata are typically coal belonging to the high-ash 3400 bench. NOTE: This presentation of this modeling and reserve configuration is presented for informational purposes only. Reserves are not projected exclusive of the lower leader rash zone. While mining practices can periodically isolate the lower rash zone and exclude it from the mineable section, the report authors have opted to include the lower rash zone tonnage and associated quality degradation for reserve computations.
3. The 4000 + 3800 (upper leader) + 3400 (lower leader): typical range from 7.00 to 8.50 feet within mine plan areas. The base of this mining scenario is defined by the CLRLF tag. (Refer to *Map 1* in the *Appendix*.) A thin shale parting occurs between the 3800 and 3400 benches, ranging from 0.00 to 0.10 feet in thickness; the immediate floor underlying the 3400 bench is dark gray to black shale, with occasional fireclay.

The Clarion seam is situated below drainage throughout the Property and is accessible by existing slopes and shafts. Depending upon the thickness of the 4000 bench, and the underlying 3800 and 3400 benches, the composition of the mine floor can vary significantly across the projected mine area, from coal to carbonaceous shale to clayey shale or fireclay.

The lithologic composition of the immediate roof strata consists of dark gray to carbonaceous shale which typically coarsens upward to sandy shale and occasionally sandstone. Moreover, some areas of the mine roof demonstrate the influence of sandstone paleochannels (refer to *Exhibit 2* in the *Appendix* of this report), where finer-grained clastics have been entirely scoured within the immediate roof of the seam and replaced with sandstone strata.

7 Exploration

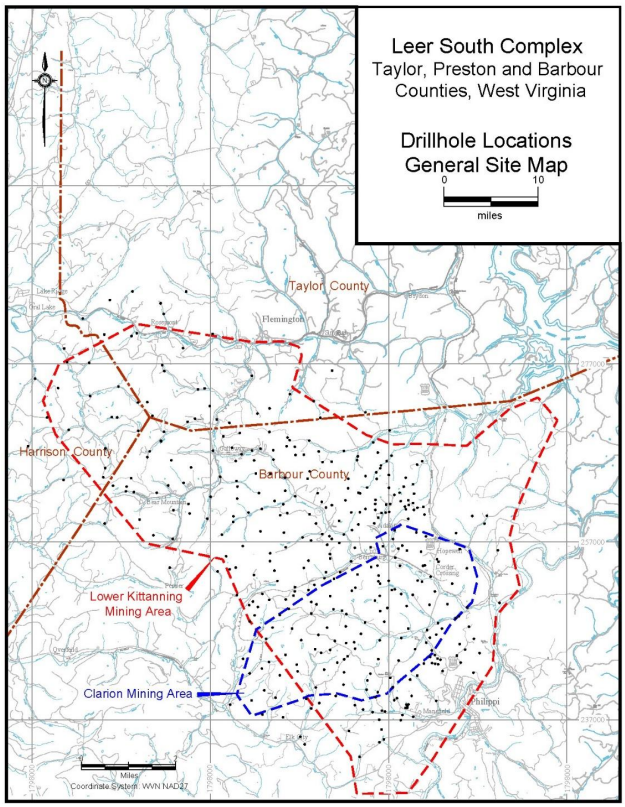
7.1 Nature and Extent of Exploration

All Arch Resources exploration pertaining to long-range planning and reserve definition-based work consists of core drilling. No other forms of exploration have been carried out on the Leer South mine property, with the exception of channel sampling which is utilized for short term planning and quality projections.

Since 2011 Arch Coal Inc./Arch Resources Inc. has drilled approximately 95 core holes for the Lower Kittanning seam and 88 drill holes for the Clarion seam in the Leer South mine reserve. All drill holes were cored with core samples sent to **Standard Laboratory Inc. (*Standard*)** for quality analyses and to **Appalachian Mining and Engineering, Inc. (*AME*)** for strength testing.

Extensive exploration in the form of subsurface drill efforts has been carried out on the Property by numerous entities, most of which were completed prior to the acquisition by Arch. Diamond core, and CBM drilling are the primary types of exploration on the Property. Data for correlation and mining conditions are derived from core descriptions and geophysical logging (e-logging). Coal quality analyses were also employed during the core exploration process. A total of 1,761 points of observation (drill holes and mine measurements) have been used to delineate the coal resources and reserves. The location of the drilling is shown on the maps included in *Figure 7-1.*

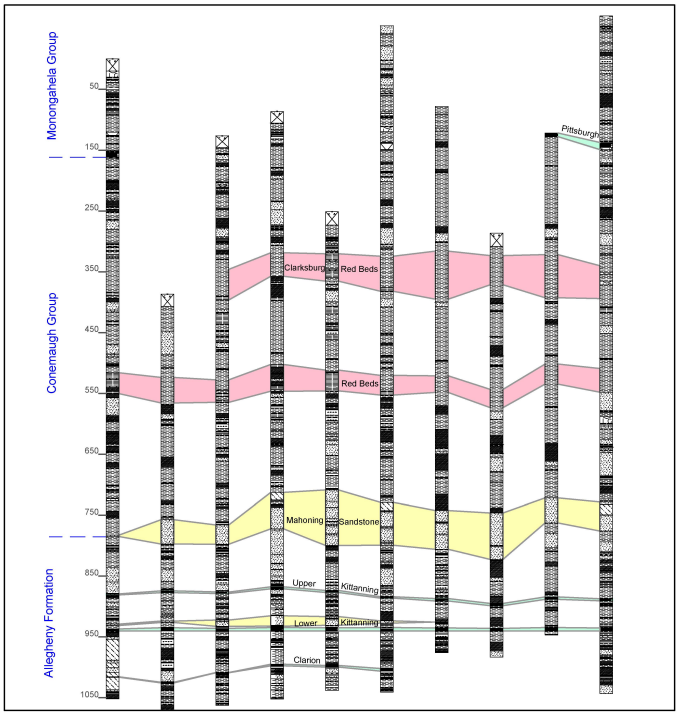
Figure 7-1: Drillhole Location Map



The concentration of exploration varies slightly across the Property, with the proposed underground mining areas having the highest concentration of drill holes. Drilling on the Property is typically sufficient for delineation of potential underground mineable benches. Core logging is carried out by professional geologists for all drillholes. Geophysical logging (e-logging) techniques, by contrast, document specific details useful for geologic interpretation and mining conditions. Given the variability of data-gathering methods, *definitive* mapping of future mining conditions may not be possible, but projections and assumptions can be made within a *reasonable* degree of certainty and are supported by successful ongoing operations in the same horizons by Arch.

A significant effort was put into verifying the integrity of the database. Once this was established, stratigraphic columnar sections were generated using cross-sectional analysis to establish or confirm coal seam correlations. A typical cross-section is shown in *Figure 7-2*.

Figure 7-2: Generalized Leer South Cross-Section



Due to the long history of exploration by various parties on the Property, a wide variety of survey techniques exist for documentation of data point locations. Older exploration drill holes may have been located by survey and more recently completed drill holes are often located by high-resolution Global Positioning System (*GPS*) units. However, some older holes have been approximately located using USGS topography maps or other methods which are less accurate. Therefore, discretion had to be used regarding the accuracy for the location and ground surface elevation of some of these older drill holes. In instances where a drill hole location (or associated coal seam elevations) appeared to be inconsistent with the overall structural trend (or surface topography for surface-mineable areas), the data point was

not honored for geological modeling. Others with apparently minor variances were adjusted or then used by MM&A .

Surveying of the underground and surface mined areas has been performed by the mine operators and/or their consulting surveyors. By assignment, MM&A did not verify the accuracy or completeness of supplied mine maps but accepted this information as being the work of responsible engineers and surveyors.

MM&A compiled comprehensive topographic map files by selecting the best available aerial mapping for each area and filling any gaps with digital USGS topographic mapping.

7.2 Non-Drilling Procedures and Parameters

Exploration work associated with long term mine planning predominantly consists of core drilling. Additionally, short term mine planning and quality projections utilize channel sampling obtained from existing mine workings. No other forms of exploration have been carried out on the Leer South mine property.

7.3 Drilling Procedures

Arch Land exploration consists of continuous core drilling using contract drilling companies. HQ core (3.76-inch diameter drillhole yielding 2.5-inch core samples) is normally used in the Leer South mine property. Exploration drilling provides core samples of roof strata, the coal seam and floor strata. Roof and floor strata samples are typically sent for geotechnical strength testing. Coal seam cores are sent to certified laboratories for quality analyses; and some coal cores are placed in sealed canisters to determine gas content and gas composition. Upon completion of each site, the drill holes are geophysically logged where caliper, density, gamma, resistivity and sonic logs are run. In accordance with Arch Land's procedures and standards for exploration, each drill site location is surveyed.

Geologic logs were provided to MM&A as part of a geological database. MM&A geologists were not involved in the production of original core logs but did perform a basic check of information within the provided database. Where geophysical logs for such holes are available, they were used by MM&A geologists to verify the coal thickness and core recovery of seams.

7.4 Hydrogeology

Mining in Leer South in both the Lower Kittanning and Clarion coal seams will be below surface drainage. In general, the hydrogeologic system for Leer South is similar to that of longwall mining in the Leer Mine to the north. As such, longwall mining in the Lower Kittanning seam in Leer South is expected to involve stream undermining, undermining of aquifers, and mining through coalbed methane wells. In addition, longwall mining in Leer South will occur beneath previous above-drainage mining in the Pittsburgh coal seam; however, with an average interburden thickness of approximately 800 feet between the Lower Kittanning and the Pittsburgh seams, the potential for adverse interaction

is not expected. MM&A provided predictive longwall subsidence modeling for Leer South to facilitate planning of post-mining hydrogeologic conditions. Based upon the successful history of the operation at Leer Mine with regard to hydrogeological features, and the generally similar nature of the hydrogeologic conditions at Leer Mine and Leer South, MM&A assumes that the Leer South operation has the knowledge and experience to minimize and mitigate potential hydrogeologic concerns.

7.5 Geotechnical Data

Mining plans for potential underground mines were developed by Arch and modified by MM&A to fit current property constraints. Pillar stability for longwall operations in the Lower Kittanning seam was checked by MM&A using the Analysis of Coal Pillar Stability (*ACPS*) program. ACPS integrates the older Analysis of Retreat Mining Pillar Stability (*ARMPS*), Analysis of Longwall Pillar Stability (*ALPS*), and Analysis of Multiple Seam Stability (*AMSS*) software packages (originally developed by the **National Institute for Occupational Safety and Health [*NIOSH*]**) into a single pillar design framework. MM&A reviewed the results from the ACPS analysis and considered them in the development of the LOM plan.

MM&A conducted a mine visit in October 2020 to observe mine conditions. During the visit, MM&A observed conditions in a room-and-pillar section of the Clarion seam and in the main entries in the Lower Kittanning seam. Evidence of horizontal stress was noted in the mains entries and in the right rib of three working faces in the Lower Kittanning seam. The ground control system included steel wire mesh with eight foot fully grouted bolts, cable bolts, truss bolts and rib bolts. MM&A verified appropriate orientations of the Leer South mine plans using Analysis of Horizontal Stress in Mining (*AHSM*).

8 Sample Preparation Analyses and Security

8.1 Prior to Sending to the Lab

Prior to Arch's acquisition of the Property, the protocol for preparing and testing samples has varied over time and is not fully documented for the older holes drilled on the Property. Typical core-drilling sampling methods for coal in the United States involves drilling through the seam, removing the core from the barrel, describing the lithology, wrapping the sample in a sealed plastic sleeve and placing it lengthwise into a covered core box, and carefully marking hole ID and depth intervals on each box and lid, allowing the core to be delivered to a laboratory in correct stratigraphic order, and with original moisture content. This process has been the norm for both historical and ongoing exploration activities at the Leer South Property.

This work is typically performed by the supervising driller, geologist, or company personnel. Samples are most often delivered to the company by the driller after each shift or acquired by company personnel or representatives. MM&A did not participate in the collection, sampling, or analysis of the core samples. However, it is reasonable to assume, given the consistency of quality from previous

operators, that these samples were generally collected and processed under industry best practices. This assumption is based on MM&A's familiarity with the operating companies and the companies used to perform the analyses.

Subsequent to acquisition of the Property by Arch, routine exploration procedures have included the placement of target coal seams from the core barrel into a plastic lined wooden core box. The coal seam is then measured and described by the geologist. The coal sample is then covered in plastic with the wooden box sealed. Cardboard dividers and foam tubing are used to tightly pack and cushion the coal sample within the wooden box. The coal core boxes are transported to the Arch Land core shed at Tucker Run where they are locked in a secure building. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. Within two weeks of completion of the core hole, the coal samples are removed from the wooden core boxes and placed in sealed plastic bags. The samples are coded and labelled with sample identification numbers based on drillhole id (DT2001), sample sequence (A, B, C, etc..), and sample number, (1, 2, 3 etc..). (Example DT2001A1 = first sample of first seam in drillhole DT2001.)

8.2 Lab Procedures

Coal-quality testing has been performed over many years by operating companies using different laboratories and testing regimens. Some of the samples have raw analyses and washabilities on the full seam (with coal and rock parting layers co-mingled) and are mainly useful for characterizing the coal quality for projected production from underground mining. Other samples have coal and rock analyzed separately, the results of which can be manipulated to forecast underground mining quality. Care has been taken to use only those analyses that are representative of the coal quality parameters for the appropriate mining type for each sample. Unlike many Appalachian properties, Leer South only has interest in two deep seams.

Standard procedure upon receipt of core samples by the testing laboratory is to: 1) log the depth and thickness of the sample; then 2) perform testing as specified by a representative of the operating company. Each sample is then analyzed in accordance with procedures defined under **American Society for Testing and Materials (*ASTM*)** standards including, but not limited to washability (ASTM D4371); ash (ASTM D3174); sulfur (ASTM D4239); Btu/lb. (ASTM D5865); volatile matter (ASTM D3175); Free Swell Index (*FSI*) (ASTM D720).

Subsequent to acquisition of the Property by Arch, quality samples are bagged and labelled, the samples are initially delivered to Standard for quality analyses. Quality samples go to Standard Lab in Bellington, West Virginia for sample preparation (crushing, splitting and sizing), Proximate, Washability, Ash Fusion, Ultimate, Ash Mineral Analyses, Dilatometer and Plastometer (coking) analyses and Trace Elements analyses. Standard ships splits of the samples to the **SGS North America Inc. (*SGS*)** lab in Sophia, West Virginia for petrographic analyses.

Standard and SGS are contracted for performing quality analyses for Arch Resources; each of these is a certified coal quality testing facility.

According to Arch's protocols, quality control procedures are followed by its geologists to protect sample integrity and to ensure core samples are always under their control. Once core samples have been analyzed, field geologists scrutinize the resulting quality data for accuracy. Once satisfied the data reports are accurate, the quality analyses are entered into the CoalAccess database. Upon data entry completion, the modelling geologists export the data and inspects the data for variance from expected norms. If any data shows outside the norm for the Property, the data is checked against lab results to ensure proper data entry. Quality data is gridded and mapped, and anomalous data (or "bullseyes") in the data mapping is investigated. If the anomalous data is accurate, those items are brought to the attention of the mine engineers and sales staff.

Arch Land procedures for quality analyses provide a full range of coal quality analyses so engineers and sales staff working with the data have a complete listing of the coal seam quality for each drill hole completed by Arch Land.

Each company engaged in coal mining has its own parameters for coal core quality analyses. Many companies tailor their quality analyses procedures for particular coal seam, particular properties and for particular preparation plants. Arch Land quality testing is designed to provide Arch engineers and sales staff with an extensive or full catalog of coal quality analyses.

9 Data Verification

9.1 Procedures of Qualified Person

All data generating procedures undertaken by Arch Land geologists have redundant data processing steps designed to ensure all data generated and used is checked and cross checked for accuracy.

Drill hole locations are surveyed to ensure accurate locations. Drill holes are e-logged to ensure seam thickness and interburden thickness recorded by drillers and geologists are accurate. All original drillhole, survey, geologic, geophysical and quality data is scanned and stored on Arch's server so it can be accessed and checked by any Arch engineering or Sales personnel against the database, modeling and mapping.

MM&A reviewed the Arch supplied digital geologic databases. The database consists of data records, which include drill hole information for holes that lie within and adjacent to the Property and records for numerous supplemental coal seam thickness measurements. Upon completion of the database verification, copies of a subset of records were printed on a test-case basis, and cross referenced to the original document for verification. Once the initial integrity of the database was established, stratigraphic columnar sections were generated using cross-sectional analysis to establish or confirm

coal-seam correlations. Geophysical logs were used wherever available to assist in confirming the seam correlation and to verify proper seam thickness measurements and recovery of coal samples.

After establishing and/or verifying proper seam correlation, seam data-control maps and geological cross-sections were generated and again used to verify seam correlations and data integrity. Once the database was fully vetted, seam thickness, base-of-seam elevation, roof and floor lithologic information, and overburden maps were independently generated for use in the mine planning process.

9.2 Limitations

As with any exploration program, localized anomalies cannot always be discovered. The greater the density of the samples taken, the less the risk. Once an area is identified as being of interest for inclusion in the mine plan, additional samples are taken to help reduce the risk in those specific areas. In general, provision is made in the mine planning portion of the study to allow for localized anomalies that are typically classed more as a nuisance than a hinderance.

9.3 Opinion of Qualified Person

Sufficient data have been obtained through various exploration and sampling programs and mining operations to support the geological interpretations of seam structure and thickness for coal horizons situated on the Leer South Property. The data are of sufficient quantity and reliability to reasonably support the coal resource and coal reserve estimates in this TRS.

10 Mineral Processing and Metallurgical Testing

10.1 Testing Procedures

Coal core samples generated by Arch Land drilling and channel samples taken within the Leer South mine are subjected to metallurgical testing at Standard and SGS. Metallurgical testing consists of ultimate, sulfur forms, ash mineral analyses, trace element analyses, Gieseler and Arnu (coking analyses) and petrographic analyses.

Arch Land procedures for metallurgical quality analyses provide a wide range of coal quality analyses. This provides Leer South mine engineers and Arch sales staff working with the mine have a complete listing of the Lower Kittanning coal seam quality for each drillhole and channel sample taken by Arch Land.

Separate tabulations have been compiled for basic chemical analyses (both raw and washed quality), petrographic data, rheological data and chlorine, ash, ultimate and sulfur analysis are maintained in MM&A's files.

Available coal-quality data were tabulated by resource area in Microsoft® EXCEL workbooks provided by Arch, and the details of that work are maintained on file at the offices of Arch and MM&A. These tables also provide basic statistical analyses of the coal quality data sets, including average value; maximum and minimum values; and the number of samples available to represent each quality parameter of the seam. Coal samples that were deemed by MM&A geologists to be unrepresentative were not used for statistical analysis of coal quality, as documented in the tabulations.

The projected mine plans presented for both the Clarion and Lower Kittanning seams were examined and quality borings were selected for examination in order accurately characterize the coal resources. Sampled interval information from the float sink analyses of each selected boring was correlated against MM&A developed geologic strip logs. This process determined what geologic strata was sampled in each analysis. In the case of the Clarion seam, samples were individual or combinations of the Clarion seam, the parting, the Lower Clarion, and the Floor Rash. In the Lower Kittanning samples were individual or combinations of the Lower Kittanning Rider, the parting, and the Lower Kittanning seam.

Once the type of sampled material was determined for each float sink analysis, composites were calculated for the metallurgical and thermal products. When the sample material was unsized, by zero, a cumulative float 1.50 specific gravity (*SG*) product was used to represent the metallurgical product. When a sample contained multiple size classes, a cumulative float 1.50 SG product was used for the coarse and intermediate material. Data for the fine material was generally reported at a cumulative float 1.30 or 1.35 SG product. Appropriate weight percentages were applied to each size class in order to calculate the combined metallurgical product. A SG cut point of 1.70 was used for determining the thermal product. The incremental data was calculated between the cumulative 1.50 and 1.70 SG products and this information, along with proper weight percentages for each size class, was used to calculate the combined thermal product. When multiple size classes were present, no fine material was included in the thermal product, as is the case for current production and processing at the operation.

10.1.1 Clarion Product Compositing

Production in the Clarion seam targets a mineable section that extends halfway through the Lower Clarion strata. This section is preferred, rather than mining completely through the Lower Clarion or the Floor Rash, due to a significant increase in sulfur content in the lower half of the Lower Clarion and the Floor Rash. Daily sulfur analysis is performed and modifications to cutting height are made on the sections in order to avoid this high sulfur material.

Care was taken to accurately represent this mining procedure by compositing quality data to reflect either the reported 5.5-foot minimum cutting height or a cutting height to a depth of roughly half of the Lower Clarion. Quality sampling information did not always allow for an exact match to be made in these instances, but all efforts were made to be as accurate as possible.

Product information from separate strata were composited together in order to produce the desired cutting height. Weight percentages for each stratum were determined by using their thicknesses and relative densities. In instances where the parting was not sampled or it was necessary to take unsampled rock in order to reach the minimum cutting height, a SG of 2.2 was used to represent this material. It was assumed that all material from the unsampled parting or rock would report to the sink fraction, and thus would only influence product yield and would have no influence on product quality.

A second set of quality composites were also performed for the Clarion seam. In this procedure it was assumed that the entire section would be mined through the Floor Rash. Every sampled interval was included in the quality composite for this procedure. The same procedures and assumptions were followed as previously described. The main difference being new derivations of weight percentage relationships for the individual strata in each boring to represent the full section. Where necessary, unsampled parting or unsampled rock were included with an assumed density of 2.2 SG. Again, it was assumed that all of the unsampled parting or rock material would report to the sink fraction and would have no impact on product quality but would influence product yield.

10.1.2 Lower Kittanning Product Compositing

A minimum cutting height of 7 feet was used when considering the product for the Lower Kittanning seam. Generally, this resulted in only the metallurgical and thermal product characteristics for the Lower Kittanning seam being reported. Although, in some select areas, the parting between the Lower Kittanning Rider and Lower Kittanning narrows, and a minimum cutting height of 7 feet would begin to intrude on the Lower Kittanning Rider. In these instances, metallurgical and thermal product characteristics for the Lower Kittanning Rider have also been reported.

Unlike the compositing work performed on the Clarion, where the mineable section was modeled including rock dilution where necessary, these samples are reported on a coal only basis. Unsampled parting or rock material have not been added back into the calculations in order to modify the yield.

The amount and areal extent of coal sampling for geological data is generally sufficient to represent the quality characteristics of the coal horizons and allow for proper market placement of the subject coal seams. For some of the coal deposits there are considerable laboratory data from core samples that are representative of full extent of the resource area; and for others there are more limited data to represent the resource area. For example, in the active operations with considerable previous mining, there may be limited quality data within some of the remaining resource areas; however, in those cases the core sampling data can be supplemented with operational data from mining and shipped quality samples representative of the resource area.

10.2 Relationship of Tests to the Whole

The extensive sampling and testing procedures followed in the Coal Industry typically result in a strong correlation between sample quality and Marketable product.

10.3 Lab Information

Core and channel sample quality samples are bagged and labelled; the samples are delivered to Standard for quality analyses. Quality samples go to Standard in Bellington, West Virginia for sample preparation (crushing, splitting and sizing), Proximate, Washability, Ash Fusion, Ultimate, Ash Mineral Analyses, Dilatometer and Plastometer (Gieseler and Arnu coking) analyses and Trace Elements analyses. Standard ships splits of the samples to the SGS lab in Sophia, West Virginia for petrographic analyses.

Standard and SGS are contracted to perform quality analyses for Arch, both of which are certified analytical testing laboratories.

Each sample is analyzed at area Laboratories that operate in accordance with procedures defined under ASTM standards including, but not limited to washability (ASTM D4371); ash (ASTM D3174); sulfur (ASTM D4239); Btu/lb. (ASTM D5865); volatile matter (ASTM D3175); Free Swell Index (*FSI*) (ASTM D720).

10.4 Relevant Results

Coal seam recovery estimates are based on washability analyses performed on coal cores and channel samples. Ash, sulfur, volatile matter and yield data from multiple washability fractions are modelled and mapped. Grids and mapping are provided to Leer South mine engineers for calculation of mine recovery. Mine recovery takes into account washability yield, mining method and preparation plant performance.

11 Mineral Resource Estimates

MM&A independently created a geologic model to define the coal resources at Leer South. Coal resources were estimated as of December 31, 2021.

11.1 Assumptions, Parameters and Methodology

Geological data were imported into Carlson Mining® (formerly SurvCADD®) geological modelling software in the form of Microsoft® Excel files incorporating, drill hole collars, seam and thickness picks, bottom seam elevations and raw and washed coal quality. These data files were validated prior to importing into the software. Once imported, a geologic model was created, reviewed and verified- with a key element being a gridded model of coal seam thickness. Resource tons were estimated by using the seam thickness grid based on each valid point of observation and by defining resource confidence arcs around the points of observation. Points of observation for Measured and Indicated confidence arcs were defined for all valid drill holes that intersected the seam using standards deemed acceptable by MM&A based on a detailed geologic evaluation and a statistical analysis of all drill holes within the projected reserve areas as described in *Section 11.1.1*. The geological evaluation

incorporated an analysis of seam thickness related to depositional environments, adjacent roof and floor lithologies, and structural influences.

After validating coal seam data and establishing correlations, the thickness and elevation for seams of economic interest were used to generate a geologic model. Due to the relative structural simplicity of the deposits and the reasonable continuity of the tabular coal beds, the principal geological interpretation necessary to define the geometry of the coal deposits is the proper modeling of their thickness and elevation. Both coal thickness and quality data are deemed by MM&A to be reasonably sufficient within the resource areas. Therefore, there is a reasonable level of confidence in the geologic interpretations required for coal resource determination based on the available data and the techniques applied to the data.

Table 11-1 below provides the geological mapping and coal tonnage estimation criteria used for the coal resource and reserve evaluation. These cut-off parameters have been developed by MM&A based on its experience with the Arch property and are typical of mining operations in the Central Appalachian coal basin. This experience includes technical and economic evaluations of numerous properties in the region for the purposes of determining the economic viability of the subject coal reserves.

Table 11-1: General Reserve and Resource Criteria

Item	Parameters	Technical Notes and Exceptions*
• **General Reserve Criteria**		
Reserve Classification	Reserve and Resource	
Reliability Categories	Resource (Measured, Indicated, and Inferred) Reserve (Proven and Probable)	To better reflect geological conditions of the coal deposits, distance between points of observation is standard USGS (in feet), respectively, for measured and indicated.
Effective Date of Resource Estimate	December 31, 2021	
Effective Date of Reserve Estimate	December 31, 2021	Financial modeling was conducted based off of mine faces as of October 7, 2021.
Seam Density	Variable, dependent upon seam characteristics (based on available drill hole quality).	
• **Underground-Mineable Criteria**		
Map Thickness	Total seam thickness	
Minimum Seam Thickness (Resource)	3.0 feet or 50% Estimated Visual Recovery	
Minimum Seam Thickness (Reserve)	3.0 feet for the Lower Kittanning Seam 5.5 feet for the Clarion Seam*	*Clarion seam: Estimated Visual Recovery (EVR) of 50% based on 5.50' cutting height is the principal constraint
Minimum Mining Thickness	7.0 feet for the Lower Kittanning Seam 5.5 feet for the Clarion Seam	
Minimum In-Seam Wash Recovery	50 percent	
Wash Recovery Applied to Coal Reserves	Based on average yield for drill holes within specified reserve areas.	
Out-of-Seam Dilution Thickness for Run-of-Mine Tons Applied to Coal Reserves	Based upon the delta between seam height and minimum mining criteria.	2.3 SG used for dilution tonnage estimate
Mine Barrier	Not applicable	
Adjustments Applied to Coal Reserves	No moisture addition for coal reserves—reserves reported as dry basis.	

Note: Exceptions for application of these criteria to reserve estimation are made as warranted and demonstrated by either actual mining experience or detailed data that allows for empirical evaluation of mining conditions. Final classification of coal reserve is made based on the pre-feasibility evaluation.

11.1.1 Geostatistical Analysis for Classification

MM&A completed a geostatistical analysis on drill holes within the reserve boundaries to determine the applicability of the common United States classification system for measured and indicated coal resources. Historically, the United States has assumed that coal within ¼-mile of a point of observation represents a measured resource whereas coal between ¼-mile and ¾-mile from a point of observation is classified as indicated. Inferred resources are commonly assumed to be located between ¾-mile and 3 miles from a point of observation. Per SEC regulations, only measured and indicated resources may be considered for reserve classification, respectively as proven and probable reserves.

MM&A performed a geostatistical analysis test of the Leer South data set using the Drill Hole Spacing Analysis (*DHSA*) method. This method attempts to quantify the uncertainty of applying a measurement from a central location to increasingly larger square blocks and provides recommendations for determining the distances between drill holes for measured, indicated, and inferred resources.

To perform DHSA the data set was processed to remove any erroneous data points, clustered data points, as well as directional trends. This was achieved through the use of histograms, as seen in *Figure 11-1*, color coded scatter plots showing the geospatial positioning of the borings, *Figure 11-2*, and trend analysis.

Figure 11-1: Histogram of the Total Coal Thickness for the Lower Kittanning Seam Present in the Leer South Complex

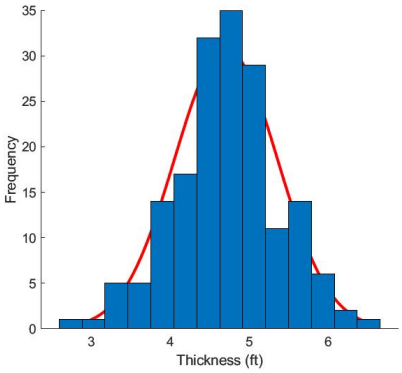
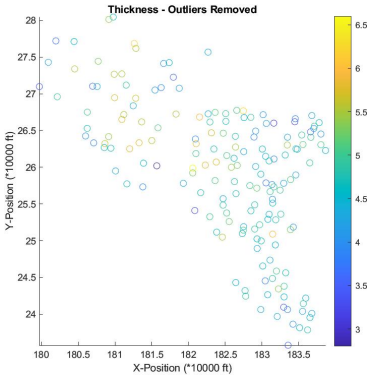
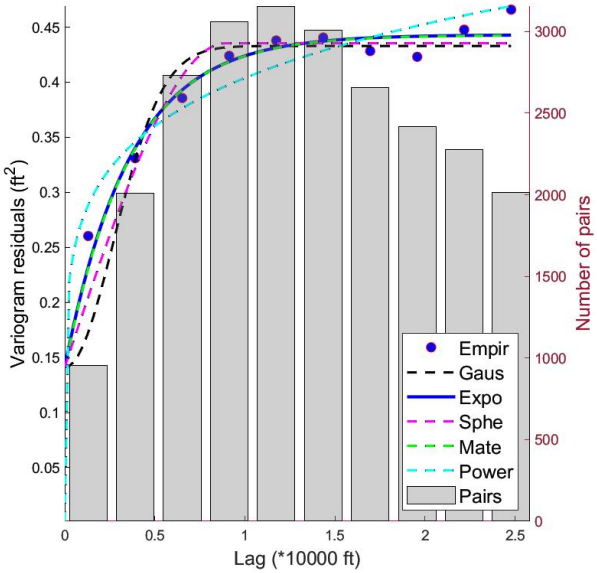


Figure 11-2: Scatter plot of the Total Coal Thickness for the Lower Kittanning Seam Present in the Leer South Complex



Following the completion of data processing, a variogram of the data set was created, *Figure 11-3*. The variogram plots average square difference against the separation distance between the data pairs. The separation distance is broken up into separate bins defined by a uniform lag distance (e.g., for a lag distance of 500 feet the bins would be 0 – 500 feet, 501 – 1,000 feet, etc.). Each pair of data points that are less than one lag distance apart are reported in the first bin. If the data pair is further apart than one lag distance but less than two lag distances apart, then the variance is reported in the second bin. The numerical average for differences reported for each bin is then plotted on the variogram. Care was taken to define the lag distance in such a way as to not overestimate any nugget effect present in the data set. Lastly, modeled equations, often spherical, gaussian, or exponential, are applied to the variogram in order to represent the data set across a continuous spectrum.

Figure 11-3: Variogram of the Total Coal Thickness for the Lower Kittanning Seam Present in the Leer South Complex



The estimation variance is then calculated using information from the modeled variogram as well as charts published by Journel and Huijbregts (1978). This value estimates the variance from applying a single central measurement to increasingly larger square blocks. Care was taken to ensure any nugget effect present was added back into the data. This process was repeated for each test block size.

The final step of the process is to calculate the global estimation variance. In this step the number square blocks that would fit inside the selected study area is determined for each block size that was investigated in the previous step. The estimation variance is then divided by the number of blocks that would fit inside the study area for each test block size. Following this determination, the data is then transformed back to represent the relative error in the 95th-percentile range.

Figure 11-4 shows the results of the DHSA performed on the Lower Kittanning seam data for the Leer South Complex. DHSA provides hole to hole spacing values, these distances need to be converted to radius from a central point in order to compare to the historical standards. A summary of the radius data is shown in *Table 11-3*. DHSA prescribes measured, indicated, and inferred drill hole spacings be determined at the 10-percent, 20-percent, and 50-percent levels of relative error, respectively.

Figure 11-4: Result of DHSA for the Lower Kittanning Seam Present in the Leer South Complex

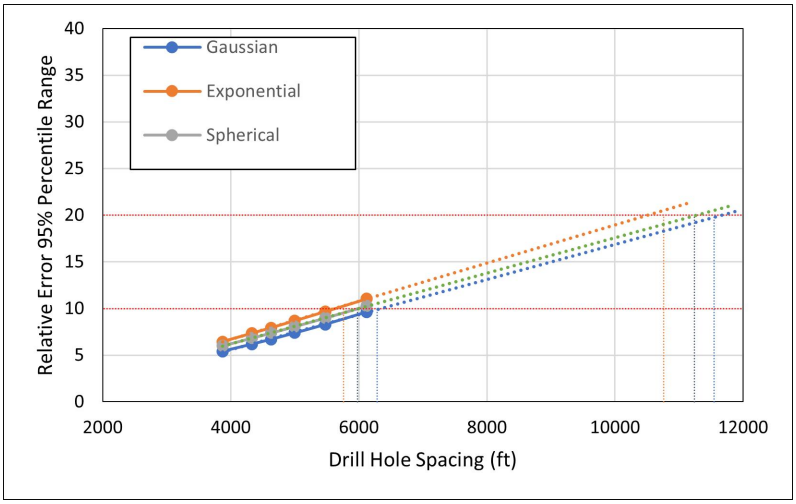


Table 11-2: DHSA Results Summary for Radius from a Central Point

Model:	Measured Radial Distance (10% Relative Error) (Miles)	Indicated Radial Distance (20% Relative Error) (Miles)	Inferred Radial Distance (50% Relative Error) (Miles)
Gaussian:	0.60	1.09	2.59
Spherical:	0.57	1.06	2.56
Exponential:	0.55	1.02	2.44

Comparing the results of the DHSA to the historical standards, it is evident that the historical standards are more conservative than even the most conservative DHSA model with regards to determining measured resources. The Exponential model recommends using a radius of 0.55 miles for measured resources compared to the historical value of 0.25 miles. With respect to indicated resources historical standards are once again more conservative than the DHSA recommendations. The Exponential model recommends using a radius 1.02 miles, while the Gaussian and Spherical models recommend a radius of 1.09 and 1.06 miles, respectively. These values exceed the historical radius of 0.75 miles. These results have led the QP's to report the data following the historical classification standards, rather than use the results of the DHSA.

11.2 Qualified Person's Estimates

Mineral resources, representing in-situ coal in which a portion of reserves are derived, are presented below. Based on the work described and detailed modelling of the areas considering all the parameters defined, a coal resource estimate, summarized in *Table 11-3*, was prepared as of December 31, 2020, for property controlled by Arch.

Pricing data as provided by Arch is described in *Section 16.2*. The pricing data assumes a weighted average domestic and international FOB-mine price of approximately $111 per ton for calendar year 2022. The weighted-average price decreases to approximately $101 per ton in year 2023 and stabilizes at approximately $97 per ton over the LOM.

Table 11-3: Coal Resources Summary as of December 31, 2021

Seam	Coal Resource (Dry Tons, In Situ, Mt)			
	Measured	Indicated	Inferred	Total
Clarion, Including Lower Floor Rash Material				
Inclusive of Reserve	9.14	0.92	0.00	10.06
Exclusive of Reserve	8.85	4.02	0.00	12.87
Total	**17.99**	**4.94**	**0.00**	**22.94**
Lower Kittanning Rider				
Inclusive of Reserve	4.92	0.48	0.00	5.40
Exclusive of Reserve	0.00	0.00	0.00	0.00
Total	**4.92**	**0.48**	**0.00**	**5.40**
Lower Kittanning				
Inclusive of Reserve	115.70	42.16	0.78	158.63
Exclusive of Reserve	0.00	0.00	0.00	0.00
Total	**115.70**	**42.16**	**0.78**	**158.63**
Grand Total				
Total	**138.60**	**47.58**	**0.78**	**186.96**

Note 1: Coal resources are reported on a dry basis. Surface moisture and inherent moisture are excluded.

11.3 Qualified Person's Opinion

While there is some level of stratigraphically controlled seam-thickness variability the Lower Kittanning coal seam at Leer South demonstrate reasonable thickness consistency according to the classification

system of **measured** (0 – 0.4 miles), **indicated** (0.4 to 1.2 miles), and **inferred** (1.2 to 4.8 miles). MM&A geologists and engineers modeled the deposit and delineated mineable regions to reflect the nature of each seam and the practicality of mining constraints. Based on MM&A's geostatistical analysis, it would be possible to extend the measured arcs slightly beyond historically accepted practices due to consistent geological settings. These results have led the QP's to report the data following the historical classification standards, rather than use the results of the DHSA.

Based on the data review, the attendant work done to verify the data integrity and the creation of an independent geologic model, MM&A believes this is a fair and accurate representation of the Leer South coal resources.

12 Mineral Reserve Estimates

12.1 Assumptions, Parameters and Methodology

Coal Reserves are classified as *proven* or *probable* considering "modifying factors" including mining, metallurgical, economic, marketing, legal, environmental, social, and governmental factors.

> **Proven Coal Reserves** are the economically mineable part of a measured coal resource, adjusted for diluting materials and allowances for losses when the material is mined. It is based on appropriate assessment and studies in consideration of and adjusted for reasonably assumed modifying factors. These assessments demonstrate that extraction could be reasonably justified at the time of reporting.

> **Probable Coal Reserves** are the economically mineable part of an indicated coal resource, and in some circumstances a measured coal resource, adjusted for diluting materials and allowances for losses when the material is mined. It is based on appropriate assessment and studies in consideration of and adjusted for reasonably assumed modifying factors. These assessments demonstrate that extraction could be reasonably justified at the time of reporting.

Upon completion of delineation and calculation of coal resources, MM&A generated a LOM plan for Leer South. The footprint of the LOM plan is shown on the resource map in *Appendix C*. The Mine plan was generated based on the forecast mine plan and permit plan provided by Arch with modifications by MM&A where necessary due to current property control limits, modifications to geologic mapping, or other factors determined during the evaluation.

Carlson Mining software was used to generate the LOM plan for Leer South. The mine plan was sequenced based on productivity schedules provided by Arch. MM&A judged the productivity estimates and plans to be reasonable based on experience and current industry practice.

At the Leer South Mine, a minimum mining height of 7 feet was used due to the longwall mining method being employed. For coal seams thinner than the assigned mining height, the difference between the

coal seam height and assigned mining height consists of OSD. Mine recovery generally varies between 40 and 60 percent for continuous mining panels, and 100 percent for longwall. Plant recovery is a function of in-seam recovery, OSD and plant efficiency factor, which is set at 95 percent.

Raw, ROM production data outputs from LOM plan sequencing were processed into Microsoft® EXCEL spreadsheets and summarized on an annual basis for processing into the economic model. Average seam densities were estimated to determine raw coal tons produced from the LOM plan. Average mine recovery and wash recovery factors were applied to determine coal reserve tons.

Coal reserve tons in this evaluation are reported at as a dry product, exclusive of inherent and surface moisture.

Pricing data as provided by Arch and is described in *Section 16.2*. The pricing data assumes a thermal sales realization (FOB-mine) of approximately $23 to $29 per ton and a coking coal sales realization of approximately $98 to $187 per ton. Realized coal prices are based upon a combination of thermal (middlings) and high-volatile A coking coal products. Realized coal prices incorporate HCC indices, adjustments from metric tons to short tons, and adjustments for transportation costs and assumed prices for thermal products. Based on projections provided by Arch, both coking and thermal products are expected to stabilize via a short-term decline.

The coal resource mapping and estimation process, described in the report, was used as a basis for the coal reserve estimate. Proven and probable coal reserves were derived from the defined coal resource considering relevant processing, economic (including technical estimates of capital, revenue, and cost), marketing, legal, environmental, socio-economic, and regulatory factors and are presented on a moist, recoverable basis.

As is customary in the US, the categories for proven and probable coal reserves are based on the distances from valid points of measurement as determined by the QP for the area under consideration. For this evaluation, measured resource, which may convert to a proven reserve, is based on a 0.25-mile radius from a valid point of observation.

Points of observation include exploration drill holes, degas holes, and mine measurements which have been fully vetted and processed into a geologic model. The geologic model is based on seam depositional modeling, the interrelationship of overlying and underlying strata on seam mineability, seam thickness trends, the impact of seam structure, intra-seam characteristics, etc. Once the geologic model was completed, a statistical analysis, described in *Section 11.1.1* was conducted and a 0.25-mileradius from a valid point of observation was selected to define Measured Resources.

Likewise, the distance between 0.25 and 0.75 of a mile radius was selected to define Indicated Resources. Indicated Resources may convert to Probable Reserves.

There are negligible Inferred Resources (greater than a 0.75-mile radius from a valid point of observation) at Leer South.

12.2 Qualified Person's Estimates

With the exception of some isolated resource blocks associated with the Clarion seam, reserve tonnage estimates provided herein report coal reserves derived from the in-situ resource tons presented in *Table 11-3*, and not in addition to coal resources. Proven and probable coal reserves were derived from the defined coal resource considering relevant mining, processing, infrastructure, economic (including estimates of capital, revenue, and cost), marketing, legal, environmental, socio-economic and regulatory factors. The coal reserves, as shown in *Table 12-1*, are based on a technical evaluation of the geology and a preliminary feasibility study of the coal deposits. The extent to which the coal reserves may be affected by any known environmental, permitting, legal, title, socio-economic, marketing, political, or other relevant issues has been reviewed rigorously. Similarly, the extent to which the estimates of coal reserves may be materially affected by mining, metallurgical, infrastructure and other relevant factors has also been considered.

Table 12-1: Coal Reserves Summary (Dry Basis) as of December 31, 2021

Seam	Demonstrated Coal Reserves (Dry Tons, Washed or Direct Shipped, Mt)								
	By Reliability Category			By Product		By Control Type			
	Proven	Probable	Total	Met ~1.5 Float SG	Thermal ~1.5 x 1.70 SG	Owned	Leased	Partially Owned	Partially Leased
Clarion, Including Lower Floor Rash Material	1.25	0.07	1.32	1.12	0.20	0.24	0.65	0.00	0.43
Lower Kittanning Rider	2.18	0.07	2.24	1.97	0.27	0.15	1.81	0.13	0.16
Lower Kittanning	42.71	18.25	60.96	52.68	8.28	53.40	4.12	2.98	0.47
Total	**46.14**	**18.39**	**64.53**	**55.77**	**8.75**	**53.79**	**6.58**	**3.11**	**1.05**
Uncontrolled	4.91	1.52	6.43	5.58	0.86				

Note:

*Uncontrolled tons are reported for informational purposes only and are not part of the reserves. Uncontrolled tonnages are contained within small mineral tracts which must be acquired for execution of the life-of-mine plan. As such, uncontrolled tonnages are included in the LOM financial model. See appendix for maps which show details of mineral control.

**Metallurgical tonnages and thermal tonnages (and associated quality) are respectively based upon an approximate 1.50 float and 1.50 x 1.70 specific gravity, as this represented the most consistent coal quality data. In reality, Arch's actual plant operating gravities vary depending upon required product specifications. See "Mineral Processing and Metallurgical Testing" chapter of report for more detailed explanation on derivation of product yields. Exploration coal quality commonly varies from saleable product quality.

Table 12-2: Summary of Quality (dry basis)

Seam	Met (~1.50 Float SG)*			Thermal (~1.5 x 1.70 SG)*		
	Ash	Sulfur	Vol	Ash	Sulfur	BTU
Clarion*	9.6	1.5	33	31.9	3.1	10,088
Lower Kittanning Rider	8.4	1.3	35	31.9	4.3	9,431
Lower Kittanning	8.8	1.3	34	34.8	2.7	8,539
Total	**8.8**	**1.3**	**34**	**34.6**	**2.8**	**8,602**

*Metallurgical tonnages and thermal quality (and associated tonnages) are respectively based upon an approximate 1.50 float and 1.50 x 1.70 specific gravity, as this represented the most consistent coal quality data. See "Mineral Processing and Metallurgical Testing" chapter of report for more detailed explanation on derivation of product yields.

**Qualities presented which correspond with each respective market placement (metallurgical and thermal) are based upon exploration information at prescribed density cutpoints. These quality estimates should be viewed as predictive—actual produced quality will vary based upon a multitude of factors, including, but not limited to: plant operating practices and associated efficiency; plant equipment circuitry; plant feed quality and size distribution; and contractual product specifications

The results of this TRS define an estimated 64.5 Mt of proven and probable marketable coal reserves. Of that total, 72 percent are proven, and 28 percent are probable. There are 53.8 Mt of owned coal reserves and 6.6 Mt of leased coal and 4.2 Mt of partial control reserves. Of the 64.5 Mt of marketable reserves, approximately 86-percent are associated with metallurgical coal markets, and all of the Leer South reserves are assigned.

12.3 Qualified Person's Opinion

The estimate of coal reserves was determined in accordance with the SEC S-K1300 standards.

The LOM mining plan for Leer South was prepared to the level of preliminary feasibility. Mine projections were prepared with a timing schedule to match production with coal seam characteristics. Production timing was carried out from current locations to depletion of the coal reserve area. Coal reserve estimates could be materially affected by the risk factors described in *Section 22.2*.

Based on the preliminary feasibility study and the attendant economic review, MM&A believes this is a fair and accurate calculation of the Leer South coal reserves.

13 Mining Methods

13.1 Geotech and Hydrogeology

The hydrogeologic conditions to be encountered by mining at Leer South are expected to be generally similar to those at the current Leer operation. The Leer South mine will be below drainage and will involve undermining of surface streams and groundwater aquifers. The Leer South mine will also be undermining previous above-drainage mine workings in the Pittsburgh coal seam; however, with the average interburden between the Lower Kittanning and the Pittsburgh seams being approximately 800 feet, the potential for interaction is considered minimal. MM&A did not observe any adverse

hydrogeologic conditions in the existing portion of Leer South during an October 2020 mine visit. In addition, MM&A completed predictive longwall subsidence modeling for the proposed Leer South mine to assist Arch with planning for post-mining hydrogeologic conditions.

The mine plans for Leer South were developed by Arch and reviewed by MM&A. Pillar stability in the Lower Kittanning seam was checked by MM&A using the ACPS program, which integrates the original NIOSH-developed ARMPS, ALPS, and AMSS software packages into a single pillar design framework. MM&A also utilized AHSM (developed by NIOSH) to check the orientation of the proposed mining in relation to available principal horizontal stress directions for the region. Historical knowledge of mining in the area and observations from an October 2020 mine visit by MM&A indicate that horizontal stress conditions are likely to be present during mining in Leer South. As observed by MM&A, current Leer South operations are taking steps to mitigate the horizontal stress, including enhanced ground control measures and strategic mine layout orientation.

13.2 Production Rates

The Leer South mine is active with five continuous mining sections and one longwall section currently operating in the Lower Kittanning Seam and four continuous miner units operating in the Clarion Seam. Continuous Miner operations at Leer South by Arch and its predecessor have been ongoing for many years. Longwall Mining has been ongoing for a number of years at Arch's nearby Leer Mining Complex which operates in the Lower Kittanning Seam, with longwall mining commencing at Leer South in 2021. The mine plan and productivity expectations reflect historical performance and efforts have been made to adjust the plan to reflect future conditions. MM&A is confident that the mine plan is reasonably representative to provide an accurate estimation of coal reserves. Mine development and operation have not been optimized within the TRS.

Longwall production is scheduled for approximately 343 to 363 days each year, which represents production on seven days per week with allowances for holidays and longwall moves. On each day, the continuous mining sections and longwall produce coal on two shifts with an idle maintenance shift. The sections are configured as regular sections with one continuous miner available for production on each section. During mains development, two production units are brought together to work as a Super Section arrangement (two CM units operating on the same conveyor belt feeder). Productivity is planned at the rate of 100 feet of advance per shift of operation for the single continuous miner sections, 180 feet of advance per shift of operation for the Super Section miner sections and 50 feet per day of longwall retreat. Productivities are expected to increase moderately over time and reasonable ramp up expectations to increase productivity are included in the Arch model.

Carlson Mining software was used by MM&A to generate mine plans for the underground mineable coal seam. Mine plans were sequenced based on productivity schedules provided by Arch, which were based on historically achieved productivity levels. All production forecasting ties assumed production rates to geological models as constructed by MM&A's team of geologists and mining engineers.

As shown in *Table 13-1*, the areas planned for underground production continue until 2039. Clean coal production varies directly with coal thickness and the number of continuous miner units operating during a calendar year.

Table 13-1: Summary of Production by Year (Moist Tons x 1,000)

Mine Name	2021	2022	2023	2024	2025	2026	2027	2028
Clarion Deep Mine (CM Only)	212	558	493	335	28	0	0	0
Kittanning Deep Mine (LW)	679	4,162	3,962	4,471	4,702	4,569	4,647	4,491
Total	**892**	**4,720**	**4,455**	**4,806**	**4,730**	**4,569**	**4,647**	**4,491**
Mine Name	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Clarion Deep Mine (CM Only)	0	0	0	0	0	0	0	0
Kittanning Deep Mine (LW)	4,303	4,405	4,864	4,334	3,920	3,997	4,306	4,338
Total	**4,303**	**4,405**	**4,864**	**4,334**	**3,920**	**3,997**	**4,306**	**4,338**
Mine Name	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**
Clarion Deep Mine (CM Only)	0	0	0	0	0	0	0	0
Kittanning Deep Mine (LW)	4,487	4,633	654	0	0	0	0	0
Total	**4,487**	**4,633**	**654**	**0**	**0**	**0**	**0**	**0**

13.3 Mining Related Requirements

Although the Continuous Miner Sections are significantly more expensive to operate on a cost-per-ton basis, they are necessary to develop areas of the mine for longwall production. At the time of this study Leer South had five (5) operating continuous miner stations that were used to develop main entries and gate roads in preparation for the longwall operations in the Lower Kittanning Seam. As the mine develops, this number will reduce as CM development gains on the longwall move times. An additional four (3) continuous miner units were operating in the Clarion Seam which will complete mining during a two-year to four-year period.

13.4 Required Equipment and Personnel

The Leer South Mine is transitioning from a continuous miner operation to a longwall operation. The longwall is only planned to operate in the Lower Kittanning seam, with the Clarion operations only utilizing continuous mining units. Equipment for the longwall mining unit will be acquired and the continuous miner units will purpose to providing longwall panels for the longwall unit to mine.

The longwall shearing machine is used for extraction of coal at the production face. A chain conveyor is used to remove coal from the longwall face for discharge onto the conveyor belt which then ultimately deliver it to an underground storage bunker. Development for the longwall is conducted by the extraction of coal from the production faces using continuous miners and haulage using shuttle cars to a feeder-breaker located at the tail of the section conveyor belt. The feeder-breaker crushes large pieces of coal and rock and regulates coal feed onto the mine conveyor. Roof-bolting machines are used for to support the roof on the development sections of the longwall mines. Roof-bolting machines are used to install roof bolts, and battery scoops are available to clean the mine entries and assist in

delivery of mine supplies to work areas. Other supplemental equipment such as personnel carriers, supply vehicles, etc., are also used daily.

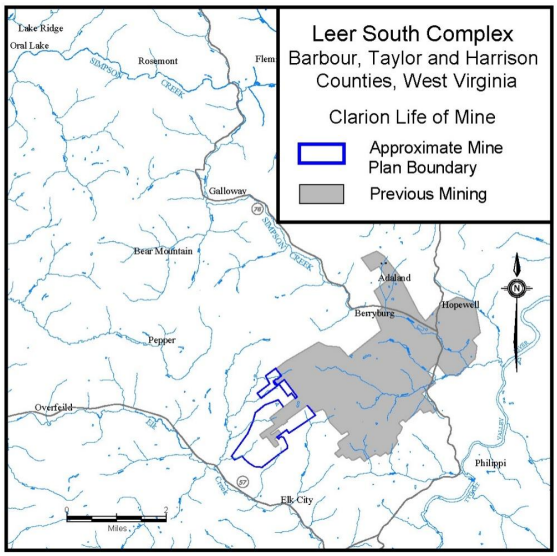
Mine conveyors typically range in width from 42 inches to 72 inches. Multiple belt flights are arranged in series to deliver raw coal to the underground storage. Along the main and sub-main entries and panels, a travel way is provided for personnel and materials by rubber-tired equipment or on rail. Leer South utilizes a slope belt in order to transport ROM coal from the Lower Kittanning seam level underground storage bunker through a haulage slope to the underlying Clarion Seam workings and then through the Clarion Seam slope to the surface where the coal may be sampled, crushed and washed in the preparation plant and stockpiled to await shipment.

Surface ventilation fans are installed as needed to provide a sufficient volume of air to ventilate production sections, coal haulage and transport entries, battery charging stations, and transformers in accordance with approved plans. High-voltage cables deliver power throughout the mine where transformers reduce voltage for specific equipment requirements. *The Mine Improvement and New Emergency Response Act of 2006* (*MINER Act*) requires that carbon monoxide detection systems be installed along mine conveyor belts and that electronic two-way tracking and communications systems be installed throughout underground mines. Water is required to control dust at production sections and along conveyor belts, and to cool electric motors. Water is available from nearby sources and is distributed within the mine by pipelines as required. A maximum total of 490 salary and hourly employees will be assigned to the Lower Kittanning Seam operation. An additional 242 salary and hourly employees will staff the Clarion Seam workings until phasing out of production in 2025.

13.5 Life of Mine Plan Maps

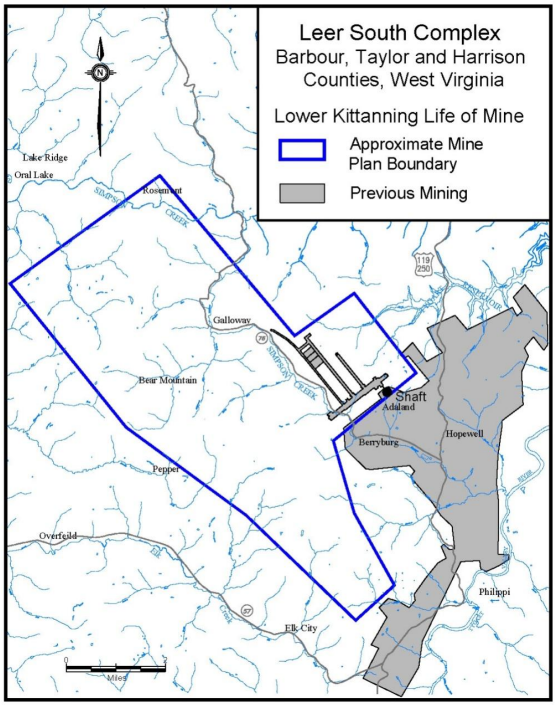
Figures 13-1 and *13-2* below depict life-of-mine maps as utilized in mine planning for the Clarion and Lower Kittanning horizons.

Figure 13-1: Clarion LOM Map



*Uncontrolled tonnages are contained within small mineral tracts which must be acquired for execution of the life-of-mine plan depicted in Figure 13-1. While the report authors anticipate that Arch will successfully acquire such mining rights, it is important to note their importance to the mining plan presented in this document. Such tons are labeled as "Uncontrolled" in summary tables provided with this document and are not included in reserve totals. More detailed mapping files are retained in Arch and MM&A's files. Such information is available at the request of the SEC.

Figure 13-2: Lower Kittanning LOM Map



* Uncontrolled tonnages are contained within small mineral tracts which must be acquired for execution of the life-of-mine plan depicted in Figure 13-2. While the report authors anticipate that Arch will successfully acquire such mining rights, it is important to note their importance to the mining plan presented in this document. Such tons are labeled as "Uncontrolled" in summary tables provided with this document and are not included in reserve totals. More detailed mapping files are retained in Arch and MM&A's files. Such information is available at the request of the SEC.

14 Processing and Recovery Methods

14.1 Description or Flowsheet

Arch currently operates a coal preparation plant at Leer South. The Leer South Plant operates at a feed rate of approximately 1,600 raw tons per hour (*tph*). Run of mine (*ROM*) coal is sent from the slope to the Raw Coal #1 stacking tube. From that point, it is reclaimed, and processing begins with the ROM

material being screened at 3 inches. Oversized material is run through a rotary breaker. The rotary breaker rejects are discarded as a refuse product. Material passing the screen and rotary breaker is sent to the Raw Coal #2 stacking tube for further processing.

The material from the Raw Coal #2 stacking tube is reclaimed and sent to the processing plant where it is screened and washed based on relative sizes. Cleaning circuitry includes a heavy media vessel (plus ½ inch material), heavy media cyclone (1/2 inch by 1-mm material), spirals (1-mm by 100-mesh), and column flotation (100-mesh by 325-mesh). All vessel and cyclone materials are initially washed at a high gravity to initially discard high ash rock. This material is then re-washed at a low gravity in a heavy media cyclone to make a metallurgical product and a secondary middlings thermal product.

Figure 14-1: Leer South Preparation Plant as Viewed from Coarse Refuse Conveyor

14.2 Requirements for Energy, Water, Material and Personnel

Personnel have historically been sourced from the surrounding communities in Barbour, Upshur, Harrison and Marion Counties, and have proven to be adequate in numbers to operate the mine. As mining is common in the surrounding areas, the workforce is generally familiar with mining practices, and many are experienced miners.

The Leer South Complex has sources of water, power, personnel, and supplies readily available for use. Water is sourced locally from a nearby abandoned underground mine and proximal overlying streams. Additionally, water is sourced from the toe of the refuse impoundment for various uses in the mine and

plant. Electricity is sourced from MonPower. The service industry in the areas surrounding the mine complex has historically provided supplies, equipment repairs and fabrication, etc.

15 Infrastructure

The Arch-owned Leer South Preparation Plant services the mine via a slope conveyor system which transports extracted coal from an underground bunker to the surface facility. The Appalachian and Ohio rail line serves as the main means of transport from the mine.

As an active operation, the necessary support infrastructure for Leer South is in place. In addition to the plant and loadout, there are also portal facilities, including personnel access to the mine, ventilation fans and a haulage slope. A photo of the existing facilities is *Figure 15-1*.

Figure 15-1: Leer South Surface Facilities

16 Market Studies

16.1 Market Description

Arch markets its primary coal product from Leer South into high volatile A coking markets. In order to meet sulfur specifications, Leer's plant operates at relatively lower gravity cut points, allowing Arch to

make a secondary, high ash product for thermal market consumption. Quality data from exploration supports assumed market placement.

High volatile coking coal is currently in high demand. Favorable market conditions for coking coal are expected over the near and long term.

Sales of high-ash, high-sulfur thermal blend coals represent a smaller portion of Leer South's revenue stream. Market influence from neighboring producers has the potential to oversupply markets for such a product. High ash, high sulfur coals are generally not consumed on a stand-alone basis, and require premium quality, low-ash, low-sulfur coals for blending to meet market specifications.

16.2 Price Forecasts

Arch provided MM&A with price forecasts for the Leer South operation. Arch's price outlook incorporates in-house knowledge of applicable rail transportation charges, ocean freight charges and port charges. Concurrent with the active operation, Leer South's production is assumed to enter coking and thermal coal markets. Pricing provided by Arch assumes applicable quality adjustments.

Realized coal prices are based upon a combination of thermal (middlings) and high-volatile A coking coal products. Realized coal prices incorporate HCC indices, adjustments from metric tons to short tons, adjustments for transportation costs and assumed prices for thermal products.

Short term forecasts for thermal blend products assume FOB-mine prices of approximately $23 per ton, increasing to $29 per ton in the short term, and stabilizing around $24 per ton over the long term. Short term forecasts for coking products assume prices of approximately $187 per ton, decreasing to $109 per ton over the long term. Long term blended (combined thermal and metallurgical) realizations are equivalent to approximately $97 per ton.

Forecasts provided by Arch are largely aligned with typical coal industry expectations of coking coal markets. In comparison to short term spot markets, Arch's estimations of realizations are somewhat conservative. Long term forecasting of metallurgical coal prices is difficult to predict. Arch's assumed long range metallurgical prices are largely aligned with typical historical averages.

16.3 Contract Requirements

Some contracts are necessary for successful marketing of the coal. For Leer South, since all mining, preparation and marketing is done in-house, the remaining contracts required are:

> **Transportation** – The Mine contracts with the Appalachian and Ohio Railway and CSX Transportation to transport the coal to either the domestic customers or to the Curtis Bay or DTA export terminal for overseas shipment.

> **Handling** – Contracts for loading vessels for export sales are necessary. These are typically handled by annual negotiations based on projected shipments.

> **Sales** – Sales contracts are a mix of spot and contract sales. With the volatility of the market, long-term contracts are not typically written.

17 Environmental Studies, Permitting and Plans, Negotiations or Agreements with Local Individuals

17.1 Results of Studies

MM&A has not conducted environmental studies on the subject property. Based upon our understanding of Arch's practices, MM&A assumes that Leer South generally has a record consistent with industry standards regarding compliance with applicable mining, water quality, and environmental laws. Estimated costs for mine closure, including water quality monitoring during site reclamation, are included in the financial models.

17.2 Requirements and Plans for Waste Disposal

Leer South has developed a slurry impoundment south of the preparation plant. Plans are in place to increase the dam crest elevation and work is progressing on downslope areas. Arch reports that it has purchased property and is in the process of permitting downstream construction of a slurry impoundment. Based on projected recovery rates, Arch reports that the impoundment will be sufficient to contain life-of-mine capacity requirements.

A new conveyor belt system has been constructed that brings coarse refuse material to the impoundment crest area. The existing coarse refuse facility northwest of the preparation plant was described as being completed during the October 2020 mine visit.

Figure 17-1: Downslope Coarse Refuse Placement on Leer South Impoundment (Photograph provided by Arch)

Figure 17-2: Coarse Refuse Stacker and Stockpile Area at Leer South (Photograph provided by Arch)

17.3 Permit Requirements and Status

All mining operations are subject to federal and state laws and must obtain permits to operate mines, coal preparation and related facilities, haul roads, and other incidental surface disturbances necessary for mining to occur. Permits generally require that the permittee post a performance bond in an amount established by the regulatory program to provide assurance that any disturbance or liability created during mining operations is properly restored to an approved post-mining land use and that all regulations and requirements of the permits are fully satisfied before the bond is returned to the permittee. Significant penalties exist for any permittee who fails to meet the obligations of the permits including cessation of mining operations, which can lead to potential forfeiture of the bond. Any company, and its directors, owners and officers, which are subject to bond forfeiture can be denied future permits under the program.[1]

New permits or permit revisions will occasionally be necessary to facilitate the expansion or addition of new mining areas on the properties, such as amendments to existing permits and new permits for mining of reserve areas. Exploration permits also are required. Property under lease includes provisions for exploration among the terms of the lease. New or modified mining permits are subject to a public advertisement process and comment period, and the public is provided an opportunity to raise objections to any proposed mining operation. MM&A is not aware of any specific prohibition of mining on the subject property and given sufficient time and planning, Arch should be able to secure new permits to maintain its planned mining operations within the context of current regulations. Necessary permits are in place to support current production on the Property, but future permits are required to maintain and expand production. Portions of the Property are located near local communities. Regulations prohibit mining activities within 300 feet of a residential dwelling, school, church, or similar structure unless written consent is first obtained from the owner of the structure. Where required, such consents have been obtained where mining is proposed beyond the regulatory limits.

Arch has obtained all mining and discharge permits to operate its mines and processing, loadout, or related facilities. MM&A is unaware of any obvious or current Arch permitting issues that are expected to prevent the issuance of future permits. Leer South, along with all coal producers, is subject to a level of uncertainty regarding future clean water permits due to **United States Environmental Protection Agency (*EPA*)** involvement with state programs.

The active Mining permits currently held by Leer South are shown in *Table 17-1.*

1 Monitored under the Applicant Violator System (AVS) by the Federal Office of Surface Mining.

Table 17-1: Leer South Mining Permit

Type	Permit ID	Permit Name	$ Bond	Current Status	Issued Date	Expiration Date	Acres	NPDES No.
Reclamation	U-15-83	Leer South	$345,280	Active	8/11/1983	1/24/2027	182.6	WV0043273
Reclamation	O-113-83	Leer South Refuse	$1,157,300	Active	8/11/1983	6/28/2023	352.3	WV0043273

17.4 Local Plans, Negotiations or Agreements

MM&A found no indication of agreements beyond the scope of Federal or State Regulations.

17.5 Mine Closure Plans

Applicable regulations require that mines be properly closed, and reclamation commenced immediately upon abandonment. In general, site reclamation includes removal of structures, backfilling, regrading, and revegetation of disturbed areas. Sediment control is required during the establishment of vegetation, and bond release generally requires a minimum five-year period of site maintenance, water sampling, and sediment control following mine completion. This requirement is reduced to two years for certain operations involving re-mining. Reclamation of underground mines includes closure and sealing of mine openings such as portals and shafts in addition to the items listed above.

Estimated costs for mine closure, including water quality monitoring during site reclamation, are included in the financial model. As with all mining companies, an accretion calculation is performed annually so the necessary Asset Retirement Obligations (*ARO*) can be shown as a Liability on the Balance Sheet.

17.6 Qualified Person's Opinion

The Leer South Mine is an operating facility; all necessary permits for current production have been obtained. MM&A knows of no reason that any permits revisions that may be required cannot be obtained.

Estimated expenditures for site closure and reclamation are included in the financial model for this site.

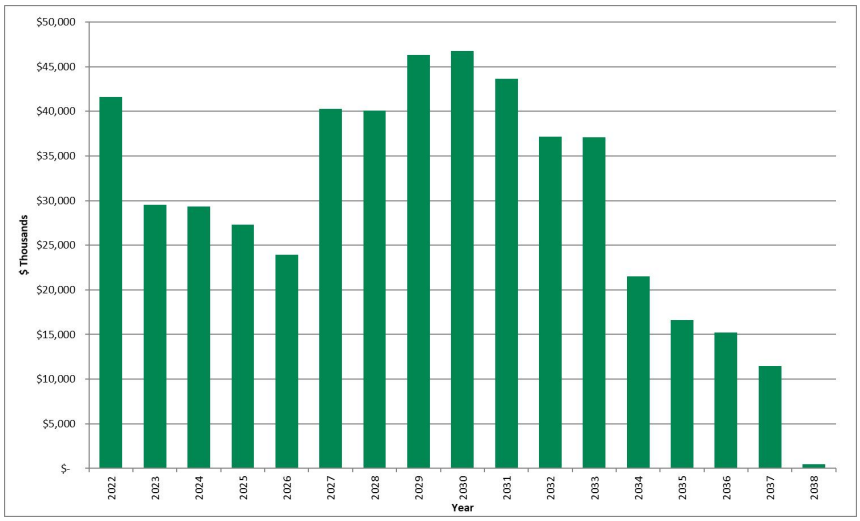
18 Capital and Operating Costs

Capital Cost Estimate

The production sequence selected for a property must consider the proximity of each reserve area to coal preparation plants, river docks and railroad loading points, along with suitability of production equipment to coal seam conditions. The in-place infrastructure was evaluated, and any future needs were planned to a level suitable for a Preliminary Feasibility Study and included in the Capital Forecast.

Arch provided MM&A with a detailed 5-year capital expenditure projection. MM&A reviewed this schedule and deemed it to be appropriate for financial modeling. MM&A extrapolated the provided capital schedule through end of mining operations. Capital forecasting by MM&A assumes that major equipment rebuilds occur over the course of each machine's remaining assumed operating life. Replacement equipment was scheduled based on MM&A's experience and knowledge of mining equipment and industry standards with respect to the useful life of such equipment. A summary of the estimated capital for the Property is provided in *Figure 18-1* below.

Figure 18-1: CAPEX



18.1 Operating Cost Estimate

Arch provided historical and projections of operating costs for MM&A's review. MM&A used the historical and/or budget cost information as a reference and developed a personnel schedule for the mine. Hourly labor rates and salaries were based upon information contained in Arch's financial summaries and MM&A's knowledge of regional labor rates. Fringe-benefit costs were developed for vacation and holidays, federal and state unemployment insurance, retirement, workers' compensation and pneumoconiosis, casualty and life insurance, healthcare, and bonuses. A cost factor for mine supplies was developed that relates expenditures to mine advance rates for roof-control costs and other mine-supply costs experienced at underground mines. Other factors were developed for maintenance and repair costs, rentals, mine power, outside services and other direct mining costs.

Other cost factors were developed for coal preparation plant processing, refuse handling, coal loading, property taxes, and insurance and bonding. Appropriate royalty rates were assigned for production from leased coal lands, and sales taxes were calculated for state severance taxes, the federal black lung excise tax, and federal and state reclamation fees.

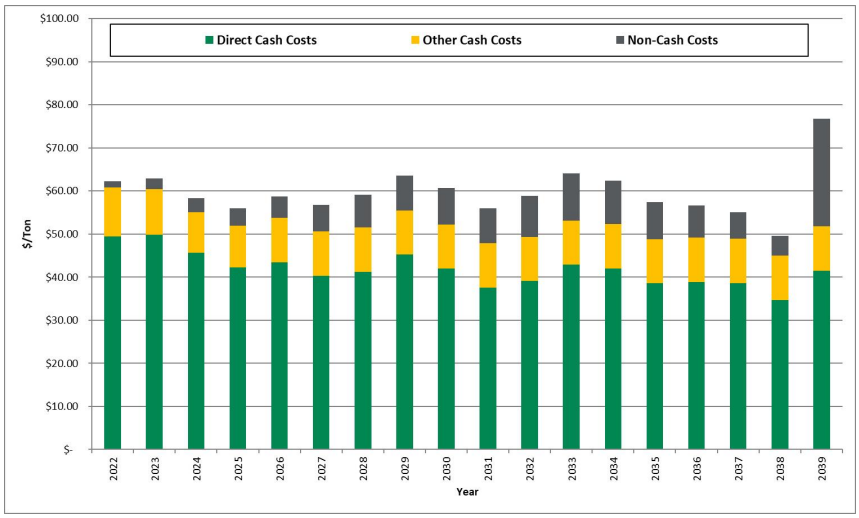
Mandated Sales Related Costs such as Black Lung Excise are summarized in *Table 18-1.*

Table 18-1: Estimated Coal Production Taxes and Sales Costs

Description of Tax or Sales Cost	Basis of Assessment	Cost
Federal Black Lung Excise Tax - Underground	Per Ton	$1.10
Federal Reclamation Fees – Underground	Per Ton	$0.12
West Virginia Reclamation Tax – Underground	Per Ton	$0.74
West Virginia Severance Tax	Percentage of Revenue	5.0%
Royalties	Percentage of Revenue	3.5%

Projected operating costs are shown below in *Figure 18-2.*

Figure 18-2: OPEX



As shown above, the Leer South Mine's average cash cost ranges between approximately $45 and $55 per ton for most of the operating period.

19 Economic Analysis

19.1 Assumptions, Parameters and Methods

A pre-feasibility LOM plan was prepared by MM&A for the Leer South operations. MM&A prepared mine projections and production timing forecasts based on coal seam characteristics and incorporated Arch's LOM projections with adjustments to reflect current property constraints and geological interpretations. Production timing was carried out from 2021 to depletion (exhaustion) of the coal reserve areas, which is projected for the year 2039. All costs and prices are based on 2021 constant United States dollars.

The Mine plan, productivity expectations and cost estimates generally reflect historical performance by Arch and efforts have been made to adjust plans and costs to reflect future conditions. MM&A is confident that the mine plan and financial model are reasonably representative to provide an accurate estimation of coal reserves.

Capital schedules were developed by MM&A for mine development, infrastructure, and on-going capital requirements for the life of the mine. Staffing levels were prepared, and operating costs estimated by MM&A. MM&A utilized historical cost data provided by Arch and its own knowledge and experience to estimate direct and indirect operating costs.

The preliminary feasibility financial model, prepared for this TRS, was developed to test the economic viability of the coal reserve area. The results of this financial model are not intended to represent a bankable feasibility study, required for financing of any current or future mining operations, but are intended to prove the economic viability of the estimated coal reserves. All costs and prices are based on 2021 constant United States dollars.

On an unlevered basis, the NPV of the project cash flows after taxes was estimated for the purpose of classifying coal reserves. The project cash flows, excluding debt service, are calculated by subtracting direct and indirect operating expenses and capital expenditures from revenue. Direct costs include labor, drilling and blasting, operating supplies, maintenance and repairs, facilities costs for materials handling, coal preparation, refuse disposal, coal loading, sampling and analysis services, reclamation and general and administrative costs. Indirect costs include statutory and legally agreed upon fees related to direct extraction of the mineral. The indirect costs are the Federal black lung tax, Federal and State reclamation taxes, property taxes, local transportation prior to delivery at rail or barge loading sites, coal production royalties, sales and use taxes, income taxes and State severance taxes. Arch's historical costs provided a useful reference for MM&A's cost estimates.

Sales revenue is based on the metallurgical coal price information provided to MM&A by Arch.

Projected debt service is excluded from the P&L and cash flow model in order to determine Enterprise Value.

The financial model expresses coal sales prices, operating costs, and capital expenditures in current day dollars without adjustment for inflation. Capital expenditures and reclamation costs are included based on engineering estimates for each mine by year. The Arch division's existing allocations of administrative costs are continued in the future projections.

Arch will pay royalties for the various current and projected operations. The royalty rates vary by mining method and location. The royalty rates for Leer South are estimated to be 3.5% of the sales revenue.

The projection model also includes consolidated income tax calculations at the Arch level, incorporating statutory depletion calculations, as well as state income taxes, and a federal tax rate of 21%. To the extent the mine generates net operating losses for tax purposes, the losses are carried over to offset future taxable income. The terms "cash flows" and "project cash flows" used in this report refer to after tax cash flows.

Consolidated cash flows are driven by annual sales tonnage, which at steady-state level ranges from a peak of 4.9 million tons in 2031 to a low of 4.0 million in 2034. Projected consolidated revenue ranges from $525 million to $382 million at steady state. Revenue totals $7.6 billion for the project's life.

Consolidated cash flow from operations is positive throughout the projected operating period, with the exception of post-production years, due to end-of-mine reclamation spending. Consolidated cash flow from operations peaks at $194 million in 2038 and totals $2.4 billion over the project life. Capital expenditures total $508 million over the project's life.

Coal price forecasts for coal products were prepared by Arch for its active operations. Such prices were used for the revenue input into the financial model. Sales variable costs such as production royalties and severance taxes were based upon the revenue input.

19.2 Results

The pre-feasibility financial model, prepared by MM&A for this TRS, was developed to test the economic viability of each coal resource area. The results of this financial model are not intended to represent a bankable feasibility study, as may be required for financing of any current or future mining operations contemplated but are intended to prove the economic viability of the estimated coal reserves. Optimization of the LOM plan was outside the scope of the engagement.

Table 19-1 shows LOM tonnage, P&L, and EBITDA for Leer South.

Table 19-1: Life-of-Mine Tonnage, P&L before Tax, and EBITDA

	LOM Tonnage	LOM Pre-Tax P&L	P&L Per Ton	LOM EBITDA	EBITDA Per Ton
Grand Total	**77,552**	**$3,057,219**	**$39.42**	**$3,583,354**	**$46.21**

*Uncontrolled tonnages are included in the LOM financial model.

** The LOM model and associated economic analysis is intended to prove the economic viability of the subject coal tonnage, allowing controlled tons to be classified as "reserve". The exercise should not be construed to represent a valuation of Arch's holdings. Long term cash flows incorporate forward looking market projections which are expected to vary over time based upon historic volatility of coal markets.

As shown in *Table 19-1,* the Leer South Mine shows positive EBITDA over the LOM. Overall, the Arch consolidated operations show positive LOM P&L and EBITDA of $3.0 billion and $3.5 billion, respectively. A summary of the key financial performance metrics projected through 2028 is provided below in *Table 19-2*.

After Tax Cash Flows were developed in order to calculate the NPV for this Property. The NPV is estimated to be $902 million at a discount rate of 14.67%. A summary of the Leer South after-tax cash flow is shown in *Table 19-2*.

Table 19-2: Leer South After-tax Cash Flow Summary ($000)*

	Total	YE 12/31 2021	YE 12/31 2022	YE 12/31 2023	YE 12/31 2024	YE 12/31 2025	YE 12/31 2026
Production & Sales tons	77,552	892	4,720	4,455	4,806	4,730	4,569
Total Revenue	$7,646,183	$147,702	$525,385	$450,499	$424,440	$425,766	$451,128
EBITDA	$3,583,354	$87,106	$238,310	$181,581	$159,714	$180,136	$205,344
Net Income	$2,399,467	$69,984	$180,534	$135,298	$116,155	$127,664	$143,725
Net Cash Provided by Operating Activities	$2,925,602	$71,998	$141,948	$157,765	$134,283	$144,741	$162,997
Purchases of Property, Plant, and Equipment	($508,198)	$0	($41,589)	($29,499)	($29,344)	($27,286)	($23,921)
Net Cash Flow	$2,417,404	$71,998	$100,360	$128,266	$104,940	$117,455	$139,075

	YE 12/31 2027	YE 12/31 2028	YE 12/31 2029	YE 12/31 2030	YE 12/31 2031	YE 12/31 2032	YE 12/31 2033
Production & Sales tons	4,647	4,491	4,303	4,405	4,864	4,334	3,920
Total Revenue	$458,920	$438,171	$419,208	$429,294	$474,115	$422,227	$381,898
EBITDA	$223,387	$207,010	$180,547	$199,286	$241,482	$208,321	$173,759
Net Income	$152,193	$135,441	$115,879	$128,072	$158,555	$131,653	$103,280
Net Cash Provided by Operating Activities	$178,818	$173,718	$156,439	$163,649	$191,984	$180,038	$153,643
Purchases of Property, Plant, and Equipment	($40,240)	($40,055)	($46,329)	($46,787)	($43,615)	($37,160)	($37,061)
Net Cash Flow	$138,578	$133,663	$110,109	$116,862	$148,369	$142,878	$116,581

	YE 12/31 2034	YE 12/31 2035	YE 12/31 2036	YE 12/31 2037	YE 12/31 2038	YE 12/31 2039	YE 12/31 2040
Production & Sales tons	3,997	4,306	4,338	4,487	4,633	654	4
Total Revenue	$389,408	$419,693	$424,958	$442,236	$456,704	$64,432	$0
EBITDA	$180,411	$209,601	$211,689	$222,902	$248,283	$30,565	($1,879)
Net Income	$110,490	$134,618	$139,401	$151,818	$175,571	$10,514	($12,974)
Net Cash Provided by Operating Activities	$151,012	$167,992	$173,103	$178,966	$194,549	$69,474	$5,805
Purchases of Property, Plant, and Equipment	($21,486)	($16,616)	($15,210)	($11,500)	($500)	$0	$0
Net Cash Flow	$129,526	$151,376	$157,893	$167,466	$194,049	$69,474	$5,805

	YE 12/31 2041	YE 12/31 2042	YE 12/31 2043	YE 12/31 2044	YE 12/31 2045	YE 12/31 2046	YE 12/31 2047
Production & Sales tons	0	0	0	0	0	0	0
Total Revenue	$0	$0	$0	$0	$0	$0	$0
EBITDA	($1,380)	($1,462)	($866)	($196)	($146)	($92)	($40)
Net Income	($2,760)	($2,924)	($1,732)	($391)	($293)	($184)	($80)
Net Cash Provided by Operating Activities	($5)	($11,446)	($12,096)	($1,022)	($1,055)	($969)	($380)
Purchases of Property, Plant, and Equipment	$0	$0	$0	$0	$0	$0	$0
Net Cash Flow	($5)	($11,446)	($12,096)	($1,022)	($1,055)	($969)	($380)

	YE 12/31 2048	YE 12/31 2049	YE 12/31 2050	YE 12/31 2051	YE 12/31 2052	YE 12/31 2053	YE 12/31 2054
Production & Sales tons	0	0	0	0	0	0	0
Total Revenue	$0	$0	$0	$0	$0	$0	$0
EBITDA	($19)	$0	$0	$0	$0	$0	$0
Net Income	($39)	$0	$0	$0	$0	$0	$0
Net Cash Provided by Operating Activities	($345)	$0	$0	$0	$0	$0	$0
Purchases of Property, Plant, and Equipment	$0	$0	$0	$0	$0	$0	$0
Net Cash Flow	($345)	$0	$0	$0	$0	$0	$0

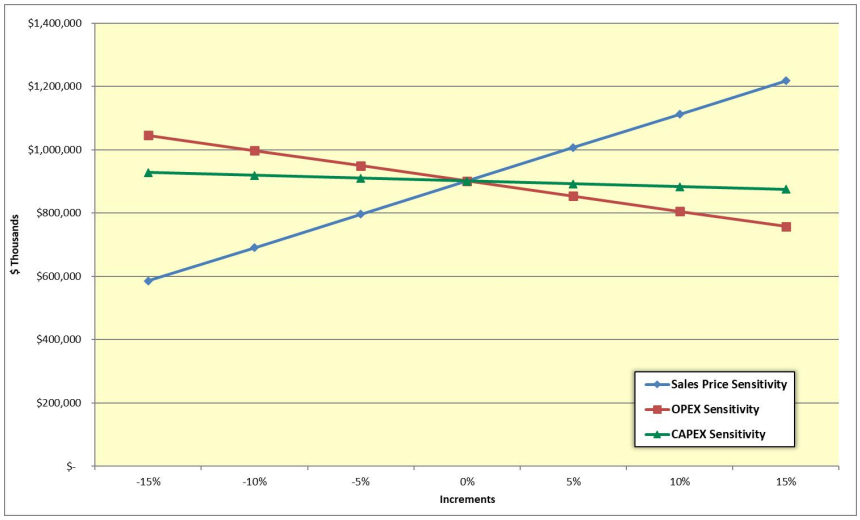
* LOM tonnage evaluated in the financial model includes 2021 production of 0.88 million clean tons.

** The LOM model and associated economic analysis is intended to prove the economic viability of the subject coal tonnage, allowing controlled tons to be classified as "reserve". The exercise should not be construed to represent a valuation of Arch's holdings. Long term cash flows incorporate forward looking market projections which are expected to vary over time based upon historic volatility of coal markets.

19.3 Sensitivity

Sensitivity of the NPV results to changes in the key drivers is presented in the chart below. The sensitivity study shows the NPV at the 14.67% discount rate when Base Case sales prices, operating costs, and capital costs are increased and decreased in increments of 5% within a +/- 15% range.

Figure 19-1: Sensitivity of NPV



As shown, NPV is quite sensitive to change in sales price and operating cost estimates, and slightly sensitive to changes in capital cost estimates.

20 Adjacent Properties

20.1 Information Used

No Proprietary information associated with neighboring properties was used as part of this study.

21 Other Relevant Data and Information

No other data was utilized as part of this study.

22 Interpretation and Conclusions

22.1 Conclusion

Sufficient data have been obtained through various exploration and sampling programs and mining operations to support the geological interpretations of seam structure and thickness for coal horizons situated on the Leer South Property. The data are of sufficient quantity and reliability to reasonably support the coal resource and coal reserve estimates in this TRS.

The geological data and preliminary feasibility study, which consider mining plans, revenue, and operating and capital cost estimates are sufficient to support the classification of coal reserves provided herein.

This geologic evaluation conducted conjunction with the preliminary feasibility study is sufficient to conclude that the 64.5 Mt of marketable underground coal reserves identified on the Property are economically mineable under reasonable expectations of market prices for metallurgical coal products, estimated operation costs, and capital expenditures.

22.2 Risk Factors

Risks have been identified for operational, technical and administrative subjects addressed in the Pre-Feasibility Study. A risk matrix has been constructed to present the risk levels for all the risk factors identified and quantified in the risk assessment process. The risk matrix and risk assessment process are modelled according to the Australian and New Zealand Standard on Risk Management (AS/NZS 4360).

The purpose of the characterization of the project risk components is to inform the project stakeholders of key aspects of the Arch projects that can be impacted by events whose consequences can affect the success of the venture. The significance of an impacted aspect of the operation is directly related to both the probability of occurrence and the severity of the consequences. The initial risk for a risk factor is herein defined as the risk level after the potential impact of the risk factor is addressed by competent and prudent management utilizing control measures readily available. Residual risk for a risk factor is herein defined as the risk level following application of special mitigation measures if management determines that the initial risk level is unacceptable. Initial risk and residual risk can be quantified numerically, derived by the product of values assigned to probability and consequence ranging from very low risk to very high risk.

The probability and consequence parameters are subjective numerical estimates made by practiced mine engineers and managers. Both are assigned values from 1 to 5 for which the value 1 represents the lowest probability and least consequence, and the value 5 represents the highest probability and

greatest consequence. The products, which define the Risk Level, are classified from very low to very high.

Risk Level Table (R = P x C)

Risk Level (R)
Very Low (1 to 2)
Low (3 to 5)
Moderate (6 to 11)
High (12 to 19)
Very High (20 to 25)

Risk aspects identified and evaluated during this assignment total 12. No residual risks are rated Very High. One (1) residual risk is rated High. Seven (7) of the risk aspects could be associated with Moderate residual risk. Four (4) of the risk aspects were attributed Low or Very Low residual risks.

22.2.1 Governing Assumptions

The listing of the aspects is not presumed to be exhaustive. Instead that listing is presented based on the experiences of the contributors to the TRS.

1. The probability and consequence ratings are subjectively assigned, and it is assumed that this subjectivity reasonably reflects the condition of the active and projected mine operations.
2. The Control Measures shown in the matrices presented in this chapter are not exhaustive. They represent a condensed collection of activities that the author of the risk assessment section has observed to be effective in coal mining scenarios.
3. Mitigation Measures listed for each risk factor of the operation are not exhaustive. The measures listed, however, have been observed by the author to be effective.
4. The monetary values used in ranking the consequences are generally-accepted quantities for the coal mining industry.

22.2.2 Limitations

The risk assessment proposed in this report is subject to the limitations of the information currently collected, tested, and interpreted at the time of the writing of the report.

22.2.3 Methodology

The numerical quantities (i.e., risk levels) attributable to either "initial" or "residual" risks are derived by the product of values assigned to probability and consequence ranging from very low risk to very high risk.

$$R = P \times C$$

Where: R = Risk Level
P = Probability of Occurrence
C = Consequence of Occurrence

The Probability (P) and Consequence (C) parameters recited in the formula are subjective numerical estimates made by practiced mine engineers and managers. Both P and C are assigned integer values ranging from 1 to 5 for which the value 1 represents the lowest probability and least consequence, and the value 5 represents the highest probability and greatest consequence. The products (R = P x C) which define the Risk Level, are thereafter classified from very low to very high.

Risk Level Table

Risk Level (R)
Very Low (1 to 2)
Low (3 to 5)
Moderate (6 to 11)
High (12 to 19)
Very High (20 to 25)

Very high initial risks are considered to be unacceptable and require corrective action well in advance of project development. In short, measures must be applied to reduce very high initial risks to a tolerable level.

As shown and discussed above, after taking into account the operational, technical, and administrative actions that have been applied or are available for action when required, the residual risk can be determined. The residual risk provides a basis for the management team to determine if the residual risk level is acceptable or tolerable. If the risk level is determined to be unacceptable, further actions should be considered to reduce the residual risk to acceptable or tolerable levels to provide justification for continuation of the proposed operation.

22.2.4 Development of the Risk Matrix

Risks have been identified for the technical, operational, and administrative subjects addressed in the TRS. The risk matrix and risk assessment process are modelled according to the Australian and New Zealand Standard on Risk Management (AS/NZS 4360).

22.2.4.1 Probability Level Table

Table 22-1: Probability Level Table

Category	Probability Level (P)		
1	Remote	Not likely to occur except in exceptional circumstances.	<10%
2	Unlikely	Not likely to occur; small in degree.	10 - 30%
3	Possible	Capable of occurring.	30 - 60%
4	Likely	High chance of occurring in most circumstances.	60 - 90%
5	Almost Certain	Event is expected under most circumstances; impossible to avoid.	>90%

The lowest rated probability of occurrence is assigned the value of 1 and described as remote, with a likelihood of occurrence of less than 2 percent. Increasing values are assigned to each higher probability of occurrence, culminating with the value of 5 assigned to incidents considered to be almost certain to occur.

22.2.4.2 Consequence Level Table

Table 22-2 lists the consequence levels.

Table 22-2: Consequence Level Table

Correlation of Events in Key Elements of the Project Program to Event Severity Category							
Category	**Severity of the Event**	**Financial Impact of the Event**	**Unplanned Loss of Production (Impact on Commercial Operations)**	**Events Impacting on the Environment**	**Events Affecting the Program's Social and Community Relations**	**Resultant Regulatory / Sovereign Risk**	**Events Affecting Occupational Health and Safety**
1	**Insignificant**	< USD $0.5 million	≤ 12 hours	Insignificant loss of habitat; no irreversible effects on water, soil and the environment.	Occasional nuisance impact on travel.	-	Event recurrence avoided by corrective action through established procedures (Engineering, guarding, training).
2	**Minor**	USD $0.5 million to $2.0 million	≤ 1 day	No significant change to species populations; short-term reversible perturbation to ecosystem function.	Persistent nuisance impact on travel. Transient adverse media coverage.	-	**First aid – lost time.** Event recurrence avoided by corrective action thought established procedures.
3	**Moderate**	USD $2.0 million to $10.0 million	≤ 1 week	Appreciable change to species population; medium-term (≤10 years) detriment to ecosystem function.	Measurable impact on travel and water/air quality. Significant adverse media coverage / transient public outrage.	Uncertainty securing or retaining essential approval / license. Change to regulations (tax; bonds; standards).	**Medical Treatment –** permanent incapacitation Avoiding event recurrence requires modification to established corrective action procedures**.**
4	**Major**	USD $10.0 million to $50.0 million	1 to 2 weeks	Change to species population threatening viability; long-term (>10 years) detriment to ecosystem function.	Long-term, serious impact on travel and use of water resources; degradation of air quality; sustained and effective public opposition.	Suspension / long-delay in securing essential approval / license. Change to laws (tax; bonds; standards).	**Fatality.** Avoiding event recurrence requires modification to established corrective action procedures and staff retraining.
5	**Critical**	>USD $50.0 million	>1 month	Species extinction; irreversible damage to ecosystem function.	Loss of social license.	Withdraw / failure to secure essential approval / license.	**Multiple fatalities.** Avoiding event recurrence requires major overhaul of policies and procedures.

The lowest rated consequence is assigned the value of 1 and is described as Insignificant Consequence parameters include non-reportable safety incidents with zero days lost accidents, no environmental damage, loss of production or systems for less than one week and cost of less than USD $0.5 million. Increasing values are assigned to each higher consequence, culminating with the value of 5 assigned to critical consequences, the parameters of which include multiple-fatality accidents, major environmental damage, and loss of production or systems for longer than six months and cost of greater than USD $50.0 million.

Composite Risk Matrix R = P x C and Color-Code Convention

The risk level, defined as the product of probability of occurrence and consequence, ranges in value from 1 (lowest possible risk) to 25 (maximum risk level). The values are color-coded to facilitate identification of the highest risk aspects.

Table 22-3: Risk Matrix

P x C = R			Consequence (C)				
			Insignificant	Minor	Moderate	Major	Critical
			1	2	3	4	5
Probability Level (P)	Remote	1	1	2	3	4	5
	Unlikely	2	2	4	6	8	10
	Possible	3	3	6	9	**12**	**15**
	Likely	4	4	8	**12**	**16**	**20**
	Almost Certain	5	5	10	**15**	**20**	**25**

22.2.5 Categorization of Risk Levels and Color Code Convention

Very high risks are considered to be unacceptable and require corrective action. Risk reduction measures must be applied to reduce very high risks to a tolerable level.

22.2.6 Description of the Coal Property

The Leer South Mine Complex is located in Barbour County, West Virginia and plans to begin operating a longwall section with the existing supporting continuous mining sections. Operations are projected to continue in the present mode until reserves are depleted in 2038.

22.2.7 Summary of Residual Risk Ratings

Each risk factor is numbered, and a risk level for each is determined by multiplying the assigned probability by the assigned consequence. The risk levels are plotted on a risk matrix to provide a composite view of the Arch risk profile. The average risk level is 7.5, which is defined as Moderate.

Table 22-4: Risk Assessment Matrix

Consequence		<10% Remote	10-30% Unlikely	30-60% Possible	60-90% Likely	>90% Almost Certain
Critical	>$50 MM	9, 10				
Major	$10-50MM				6	
Moderate	$2-10 MM	12	1,2,4	3	7	
Minor	$0.5-$2 MM			13	5	8
Low	<$0.5 MM			11		

22.2.8 Risk Factors

A high-level approach is utilized to characterize risk factors that are generally similar across a number of the active and proposed mining operations. Risk factors that are unique to a specific operation or are particularly noteworthy are addressed individually.

22.2.8.1 Geological and Coal Resource

Coal mining is accompanied by risk that, despite exploration efforts, mining areas will be encountered where geological conditions render extraction of the resource to be uneconomic, or that coal quality characteristics disqualify the product for sale into target markets.

Offsetting the geological and coal resource risk are the massive size of the controlled property which allows large areas to be mined in the preferred mine areas sufficiently away from areas where coal quality and mineability may be less favorable. This flexibility, combined with the extensive work done to define the reserve, reduces the risk at Leer South below that of other mine properties.

Table 22-5: Geological and Coal Resource Risk Assessment (Risks 1 and 2)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Recoverable coal tons recognized to be significantly less than previously estimated.	Reserve base is adequate to serve market commitments and respond to opportunities for many years. Local adverse conditions may increase frequency and cost of production unit relocations.	Previous and ongoing exploration and extensive regional mining history provide a high level of confidence of coal seam correlation, continuity of the coal seams, and coal resource tons.	3	4	**12**	Optimize mine plan to increase resource recovery; develop mine plan to provide readily available alternate mining locations to sustain expected production level.	2	3	**6**
Coal quality locally proves to be lower than initially projected.	If uncontrolled, production and sale of coal that is out of specification can result in rejection of deliveries, cancellation of coal sales agreements and damage to reputation.	Exploration and vast experience and history in local coal seams provide confidence in coal quality; limited excursions can be managed with careful product segregation and blending.	2	5	**10**	Develop mine plan to provide readily available alternate mining locations to sustain expected production level; modify coal sales agreements to reflect coal quality.	2	4	**8**

22.2.8.2 Environmental

Water quality and other permit requirements are subject to modification and such changes could have a material impact on the capability of the operator to meet modified standards or to receive new permits and modifications to existing permits. Permit protests may result in delays or denials to permit applications.

Environmental standards and permit requirements have evolved significantly over the past 50 years and to-date, mining operators and regulatory bodies have been able to adapt successfully to evolving environmental requirements.

Table 22-6: Environmental (Risks 3 and 4)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Environmental performance standards are modified in the future.	Delays in receiving new permits and modifications to existing permits; cost of testing and treatment of water and soils	Work with regulatory agencies to understand and influence final standards; implement testing, treatment and other actions to comply with new standards.	3	4	12	Modify mining and reclamation plans to improve compliance with new standards while reducing cost of compliance.	3	3	9
New permits and permit modifications are increasingly delayed or denied.	Interruption of production and delayed implementation of replacement production from new mining areas.	Comply quickly with testing, treatment and other actions required; continue excellent compliance performance within existing permits.	2	4	8	Establish and maintain close and constructive working relationships with regulatory agencies, local communities and community action groups. Prepare and submit permits well in advance of needs.	2	3	6

22.2.8.3 Regulatory Requirements

Federal and state health and safety regulatory agencies occasionally amend mine laws and regulations. The impact is industry-wide. Mining operators and regulatory agencies have been able to adapt successfully to evolving health and safety requirements.

Table 22-7: Regulatory Requirements (Risk 5)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Federal and state mine safety and health regulatory agencies amend mine laws and regulations.	Cost of training, materials, supplies and equipment; modification of mine examination and production procedures; modification of mining plans.	Participate in hearings and workshops when possible to facilitate understanding and implementation; work cooperatively with agencies and employees to facilitate implementation of new laws and regulations.	4	3	12	Familiarity and experience with new laws and regulations results in reduced impact to operations and productivity and improved supplies and equipment options.	4	2	8

22.2.8.4 Market and Transportation

Most of the current and future production is expected to be directed to domestic and international metallurgical markets. Historically the metallurgical markets have been cyclical and highly volatile. A secondary middlings product will be sent to the domestic power generation market. While this product could be considered as a byproduct with high ash and high sulfur, the economics indicate that selling the middlings product produces a minimal positive cash flow.

Table 22-8: Market and Transportation (Risk 6 & 7)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Volatile coal prices drop precipitously.	Loss of revenue adversely affects profitability; reduced cash flow may disrupt capital expenditures plan.	Cost control measures implemented; capital spending deferred.	4	5	20	High-cost operations closed, and employees temporarily furloughed.	4	4	16
Domestic middlings coal prices drop precipitously.	Loss of revenue adversely affects profitability; reduced cash flow may disrupt capital expenditures plan, product may require disposal in refuse area.	Cost control measures implemented.	4	3	12	High-cost operations closed, and employees temporarily furloughed.	4	3	12

Occasional delay or interruption of rail, river and terminals service may be expected. The operator can possibly minimize the impact of delays by being a preferred customer by fulfilling shipment obligations promptly and maintaining close working relationships.

Table 22-9: Market and Transportation (Risk 8)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Rail or river transport is delayed; storage and shipping access at river and ocean terminals is not available.	Fulfillment of coal sales agreements delayed; limited coal storage at mines may increase cost of rehandling; production may be temporarily idled.	Provide adequate storage capacity at mines; coordinate continuously with railroad and shipping companies to respond quickly and effectively to changing circumstances.	5	3	15	Provide back-up storage facility along with personnel, equipment and rehandle plan to sustain production and fulfill sales obligations timely.	5	2	10

22.2.8.5 Mining Plan

Occupational health and safety risks are inherent in mining operations. Comprehensive training and retraining programs, internal safety audits and examinations, regular mine inspections, safety meetings, along with support of trained fire brigades and mine-rescue teams are among activities that greatly reduce accident risks. Employee health-monitoring programs coupled with dust and noise monitoring and abatement reduce health risks to miners.

As underground mines are developed and extended, observation of geological, hydrogeological and geotechnical conditions lead to modification of mine plans and procedures to enable safe work within the mine environments.

Highlighted below are selected examples of safety and external factors relevant to Arch operations.

22.2.8.5.1 Methane Management

Coalbed methane is present in coal operations below drainage. Often the methane concentration in shallow coal seams is at such low levels that it can be readily managed with frequent testing and monitoring, vigilance, and routine mine ventilation. Very high methane concentrations may be present at greater depths. High methane concentrations may require degasification of the coal seam to assure safe mining. The adjacent Leer Mine has operated safely for many years in same coal seam as Leer South without coal degasification issues. In as much, it expected that Leer South Mine is expected to experience similar conditions in terms of methane management. Additionally, the presence of multilaterally drilled horizontal wells to drain methane in the subject coal beds increases the confidence associated with minimal methane issues.

Table 22-10: Methane Management (Risk 9)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Methane hazard is present in mines operating below drainage.	Injury or loss of life; possible ignition of gas and mine explosion; potential loss of mine and equipment temporarily or permanently; additional mine fan, mine power, ventilation, monitoring and examination requirements.	Low to moderate levels can be managed with frequent examinations, testing and monitoring within the mine ventilation system. Excellent rock dust maintenance minimizes explosion propagation risk should an ignition occur.	1	5	5	Very high-level methane concentrations may require coal seam degasification and gob degasification if longwall or pillar extraction methods are employed.	1	5	5

22.2.8.5.2 Mine Fires

Mine fires, once common at mine operations, are rare today. Most active coal miners have not encountered a mine fire. Vastly improved mine power and equipment electrical systems, along with safe mine practices, reduce mine fire risks. Crew training and fire brigade support and training improve response for containment and control if a fire occurs. Spontaneous combustion within coal mines, which is the source of most fires that occur today, is not expected to occur at Leer South.

Table 22-11: Mine Fires (Risk 10)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Mine fire at underground or surface mine operation.	Injury or loss of life; potential loss of mine temporarily or permanently; damage to equipment and mine infrastructure.	Inspection and maintenance of mine power, equipment and mine infrastructure; good housekeeping; frequent examination of conveyor belt entries; prompt removal of accumulations of combustible materials.	1	5	5	If spontaneous combustion conditions are present, enhanced monitoring and examination procedures will be implemented; mine design will incorporate features to facilitate isolation, containment and extinguishment of spontaneous combustion locations.	1	5	5

22.2.8.5.3 Availability of Supplies and Equipment

The industry has periodically experienced difficulty receiving timely delivery of mine supplies and equipment. Availability issues often accompanied boom periods for coal demand. Any future delivery of supplies and equipment delays are expected to be temporary with limited impact on production.

Table 22-12: Availability of Supplies and Equipment (Risk 11)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Disruption of availability for supplies and equipment.	Temporary interruption of production.	Force majeure provision in coal sales agreements to limit liability for delayed or lost sales.	3	2	6	Work closely with customers to assure delayed coal delivery rather than cancelled sales; monitor external conditions and increase inventory of critical supplies; accelerate delivery of equipment when possible.	3	1	3

22.2.8.5.4 Labor

Work stoppage due to labor protests are considered unlikely and are accompanied by limited impact should it occur. Excellent employee relations and communications limit the exposure to outside protesters. Loss of supervisors and skilled employees to retirement is inevitable; the impact can be lessened with succession planning and training and training and mentorship of new employees.

Table 22-13: Labor – Work Stoppage (Risk 12)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Work stoppage due to strikes, slowdowns or secondary boycott activity.	Loss of production and coal sales; damaged customer and employee relations; reputation loss.	Maintain excellent employee relations and communications; maintain frequent customer communications.	1	3	3	Develop plan for employee communications and legal support to minimize impact of secondary boycott activities.	1	3	3

Table 22-14: Labor – Retirement (Risk 13)

Aspect	Impact	Control Measures	Initial Risk Level			Mitigation Measures	Residual Risk Level		
			P	C	R		P	C	R
Retirement of supervisors and skilled employees.	Loss of leadership and critical skills to sustain high levels of safety, maintenance and productivity.	Monitor demographics closely and maintain communications with employees who are approaching retirement age; maintain employee selection and training programs.	3	3	9	Maintain selection of candidates and implementation of in-house or third-party training for electricians and mechanics; develop employee mentoring program.	3	2	6

23 Recommendations

MM&A recommends the implementation of all control and mitigating measures outlined in the risk analysis portion of this report to help minimize risk to the successful development of reserves outlined in this TRS.

24 References

Publicly available information from various State and Federal agencies was used where relevant.

25 Reliance on Information Provided by Registrant

For the purpose of this TRS, MM&A utilized the Geological data provided by Arch. This information was subjected to verification of its integrity and completeness.

Historical productivity and operating costs were also supplied by Arch. Arch also provided projections of costs and mine plans. This information was combined with the experience and knowledge of the QP's to forecast the LOM plan included in this study.

Ancillary mapping, including mapping depicting permit boundaries was also provided by Arch and relied upon by the report authors.

Arch provided forward looking sales realizations for inclusion in the economic analysis. Such information was honored and included by the QP's in the study.

A summary of the information provided by Arch relied upon by MM&A for the purposes of this TRS is provided in *Table 25-1*.

Table 25-1: Information from Registrant Relied Upon by MM&A

Category	Information Provided by Arch	Report Section
Legal	Mineral control and surface control rights as shown on maps	3.2, 3.3
Geological	Geologic data including digital databases and original source data including geologist logs, driller's logs, geophysical logs	9.1
Coal Quality	Database of coal quality information supplemented with original source laboratory sheets where available	10.1
Mining	Historical productivities and manpower projections.	13.2, 13.4
Coal Preparation	Flow sheet and other information related to coal processing.	14.1
Marketing	Long-term price forecast used in financial projections	16.2
Waste Disposal	Engineering data and estimates representing remaining capacities for coarse and fine coal waste disposal	17.2
Environmental	Permit and bonding information	17.3
Costs	Historical and budgetary operating cost information used to derive cost drivers for reserve financial modeling	18.2

APPENDIX

SUMMARY TABLE

Arch Land, LLC and Arch Resources, Inc.

PFS-Level 201 SEC-Compliant Resource & Reserve - Leer South Operations

Underground Mineable Coal Reserve and Resource (Short Tons) • Effective December 31, 2021

Summary Table

Appendix A - Table 1

			Coal Resource (Dry Tons, In-place)				Demonstrated Coal Reserves (Dry Tons, Washed or Direct Shipped)								
							By Reliability Category			By Prodcut		By Control Type			
	Seam	Mine Plan	Measured	Indicated	Inferred	Total	Proved	Probable	Total	Met	Thermal	Owned	Leased	Partially Owned	Partially Leased
Clarion, Including Lower Floor Rash Material															
Area 1	CLR-LF	Inclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Area 2	CLR-LF	Inclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Area 3	CLR-LF	Inclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Area 4	CLR-LF	Inclusive of Reserve	9,142,900	921,400	0	10,064,300	1,254,000	66,700	1,320,700	1,122,600	198,000	244,950	646,050	0	429,7
			9,142,900	**921,400**	**0**	**10,064,300**	**1,254,000**	**66,700**	**1,320,700**	**1,122,600**	**198,000**	**244,950**	**646,050**	**0**	**429,7**
Area 1	CLR-LF	Exclusive of Reserve	1,806,700	3,885,700	0	5,692,400	0	0	0	0	0	0	0	0	
Area 2	CLR-LF	Exclusive of Reserve	7,044,300	134,100	0	7,178,400	0	0	0	0	0	0	0	0	
Area 3	CLR-LF	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Area 4	CLR-LF	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
			8,851,000	**4,019,800**	**0**	**12,870,800**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Area 4	CLR-LF	Uncontrolled	0	0	0	0	0	121,300	121,300	103,100	18,200	0	0	0	
Lower Kittanning Seam															
North	LKT	Inclusive of Reserve	40,662,600	36,142,600	778,100	77,583,300	18,759,800	16,263,200	35,023,000	30,034,400	4,988,400	32,067,700	0	2,955,300	
Central	LKT Rider	Inclusive of Reserve	142,700	0	0	142,700	107,000	0	107,000	102,300	4,700	3,200	103,800	0	
Central	LKT	Inclusive of Reserve	51,321,100	4,472,300	0	55,793,400	18,949,000	1,828,600	20,777,600	18,156,800	2,621,000	18,344,900	2,432,700	0	
South	LKT Rider	Inclusive of Reserve	4,772,400	481,700	0	5,254,100	2,069,200	67,200	2,136,400	1,867,900	268,500	142,900	1,709,300	127,400	156,8
South	LKT	Inclusive of Reserve	23,711,800	1,541,800	0	25,253,600	5,000,700	160,600	5,161,300	4,490,400	670,900	2,984,100	1,685,500	24,500	467,2
			120,610,600	**42,638,400**	**778,100**	**164,027,100**	**44,885,700**	**18,319,600**	**63,205,300**	**54,651,800**	**8,553,500**	**53,542,800**	**5,931,300**	**3,107,200**	**624,0**
North	LKT	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Central	LKT Rider	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
Central	LKT	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
South	LKT Rider	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
South	LKT	Exclusive of Reserve	0	0	0	0	0	0	0	0	0	0	0	0	
			0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
North	LKT	Uncontrolled	0	0	0	0	846,500	1,076,500	1,923,000	1,649,100	273,900	0	0	0	
Central	LKT	Uncontrolled	0	0	0	0	1,112,100	87,700	1,199,800	1,048,400	151,300	0	0	0	
South	LKT Rider	Uncontrolled	0	0	0	0	392,100	34,400	426,500	372,900	53,600	0	0	0	
South	LKT	Uncontrolled	0	0	0	0	2,562,700	197,700	2,760,400	2,401,600	358,900	0	0	0	
			0	**0**	**0**	**0**	**4,913,400**	**1,396,300**	**6,309,700**	**5,472,000**	**837,700**	**0**	**0**	**0**	
Grand Total															
Inclusive of Reserve			129,753,500	43,559,800	778,100	174,091,400	46,139,700	18,386,300	64,526,000	55,774,400	8,751,500	53,787,750	6,577,350	3,107,200	1,053,7
Exclusive of Reserve			8,851,000	4,019,800	0	12,870,800	0	0	0	0	0	0	0	0	
Grand Total			**138,604,500**	**47,579,600**	**778,100**	**186,962,200**	**46,139,700**	**18,386,300**	**64,526,000**	**55,774,400**	**8,751,500**	**53,787,750**	**6,577,350**	**3,107,200**	**1,053,7**
Uncontrolled			0	0	0	0	4,913,400	1,517,600	6,431,000	5,575,100	855,900	0	0	0	

Uncontrolled tons are reported for informational purposes only and are not part of the reserves. Uncontrolled tonnages are contained within small mineral tracts which must be acquired for execution of the life-of-mine plan. As such, Uncontrolled tonnages are included in the LOM financial model. See appendix for maps which show details of mineral control.

Notice

Weir International, Inc. (WEIR) was retained by Arch Resources, Inc. (Arch) to prepare this Technical Report Summary (TRS) related to Arch's Black Thunder Mine. This report provides a statement of Arch's coal reserves and resources at its Black Thunder Mine and has been prepared in accordance with the United States Securities and Exchange Commission (SEC), Regulation S-K 1300 for Mining Property Disclosure (S-K 1300) and 17 Code of Federal Regulations (CFR) § 229.601(b)(96)(iii)(B) reporting requirements. This report was prepared for the sole use of Arch and its affiliates and is effective as of December 31, 2021.

This report was prepared by full-time WEIR personnel who meet the SEC's definition of Qualified Persons (QPs) with sufficient experience in the relevant type of mineralization and deposit under consideration in this report.

In preparing this report, WEIR relied upon data, written reports and statements provided by Arch. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by Arch is reasonable and reliable for use in this report.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

WEIR and its personnel are not affiliates of Arch or any other entity with ownership, royalty or other interest in the subject property of this report.

WEIR hereby consents (i) to the use of Arch's Black Thunder Mine coal reserve and resource estimates as of December 31, 2021, (ii) to the use of WEIR's name, any quotation from or summarization of this TRS in Arch's SEC filings, and (iii) to the filing of this TRS as an exhibit to Arch's SEC filings.

Qualified Person: /s/ Weir International, Inc

Date: February 10, 2022

Address: Weir International, Inc.
1431 Opus Place, Suite 210
Downers Grove, IL 60515

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13.0 Mining Methods (Cont.)

FIGURES

TABLES

1.0 EXECUTIVE SUMMARY

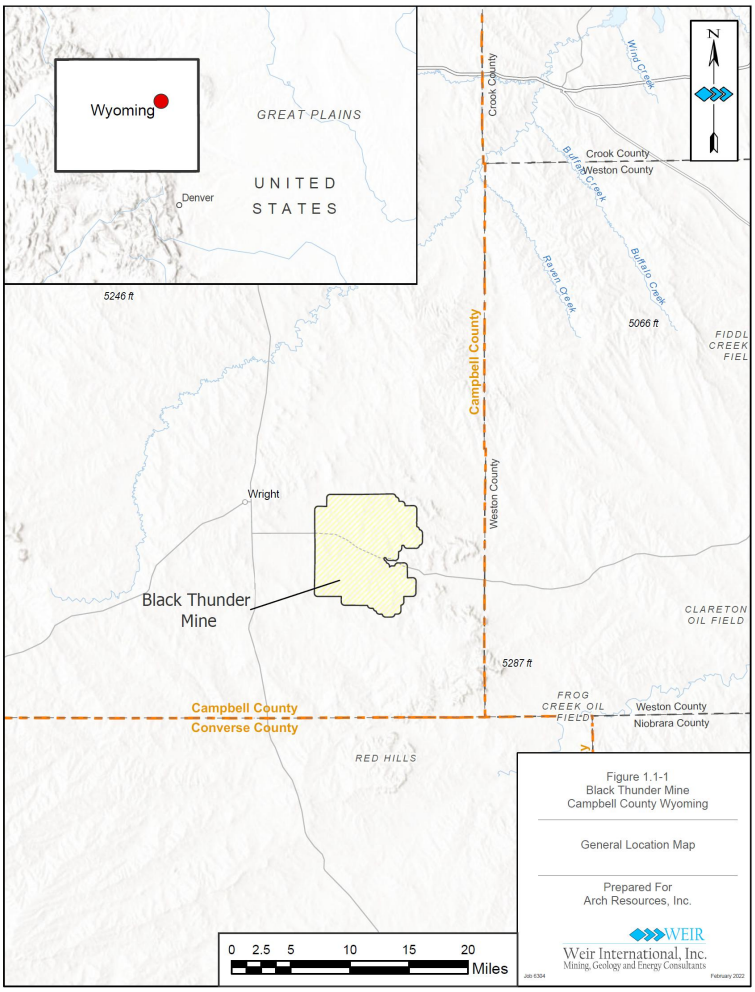
WEIR was retained by Arch Resources, Inc. (Arch) to prepare a Technical Report Summary (TRS) related to Arch's currently operating Black Thunder Mine. This report has been prepared in accordance with the United States Securities and Exchange Commission (SEC), *Regulation S-K 1300 for Mining Property Disclosure* (S-K 1300) and Title 17 Code of Federal Regulations (CFR) §229.601(b)(96)(iii)(B) reporting requirements.

1.1 PROPERTY DESCRIPTION

The Black Thunder Mine is located approximately 50 miles south of Gillette, Wyoming, in Campbell County, within the Powder River Basin (PRB) coal producing region of the United States (see Figure 1.1-1).

The Black Thunder Mine permit and reserve boundary area includes approximately 62,066 acres of controlled mineral property. Within that boundary, Arch controls the Upper and Main splits of the Wyodak Seam through 18 coal leases covering approximately 62,066 acres.

Figure 1.1-1 General Location Map



1.2 GEOLOGICAL SETTING AND MINERALIZATION

The Powder River Coal Basin, of northeastern Wyoming, lies entirely within the boundaries of the Powder River structural and topographic basin. Coal-bearing strata range in age from Upper Cretaceous in the Mesa Verde Formation to Eocene in the Wasatch Formation. The Powder River Coal Basin covers parts of Campbell, Converse, Crook, Natrona, Niobrara, Johnson, and Weston Counties and is the largest coal basin in Wyoming.

The economically mineable coal in Campbell County occurs within the Tongue River Member of the Fort Union Formation. The Wyodak coal seam occurs at the top of the Fort Union Formation and is overlain by the Wasatch Formation. The coal is low sulfur, low ash, and is subbituminous C in rank. Surface mineable coal deposits occur along the north-northwesterly striking subcrop of the Wyodak coal seam. The coal seam subcrops on the eastern edge of the lease and dips approximately two to three degrees to the west, with some slight rolling. This seam contains multiple benches or plys of coal of variable thicknesses, although in some local areas, it becomes one seam that reaches a thickness in excess of 100 feet. Across the permit area, the Wyodak Seam ranges in thickness from 10 feet to 100 feet, averaging approximately 70 feet.

1.3 EXPLORATION

Arch's exploration activities exclusively involve drilling performed by competent contract drilling companies. Exploration drilling at Black Thunder Mine has been a two-stage approach. Initial spot core drilling is conducted on a widely spaced, one-half mile, pattern in order to delineate potential lease areas. Once the area has been leased, exploration drilling is conducted three to five years in advance of pit development. Development drilling is generally conducted on a 500 feet north/south grid, with alternating rotary and spot core holes, in conjunction with dewatering endeavors. This arrangement results in a seam geometry data spacing of 500 feet and a coal quality data spacing of 1,000 feet. Drilling is conducted with rotary table drill rigs capable of drilling to depths of 1,000 feet.

All holes are geophysically logged with a standard coal suite tool consisting of gamma, density, caliper, and resistivity.

Coal sampling for the Upper split of the Wyodak Seam is in 1.0 foot increments for the top and bottom of the seam, and evenly proportioned samples of 5 to 10 feet for the remainder of the seam. Sampling for the Main split of the Wyodak Seam is in 1.5 feet increments for the top

and bottom of the seam and 10 feet increments for the remainder of the seam. All partings encountered, down to a thickness of 0.4 foot, are sampled separately.

A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any holes for poor core recovery, as all of the drillholes within the Black Thunder Mine permit area attained core recovery of at least 90 percent.

WEIR finds the planning, implementation and supervision of Arch's drilling programs, with all data derived from the drilling programs, to be consistent with industry standards, and sufficient and relevant for use in the estimation of reserves and resources.

1.4 DEVELOPMENT AND OPERATIONS

The mining method at the Black Thunder Mine is surface mining utilizing draglines and truck/shovel mining equipment. The surface mining method has been successfully utilized in the Powder River Basin since the 1970s, and in other coal producing regions of the United States.

The Black Thunder Mine is mining the Upper and Main splits of the Wyodak Seam, and parting interval within the seam, utilizing draglines, shovels, front-end loaders, trucks, dozers or scrapers in three long pits.
Historical coal production from the Black Thunder Mine is summarized as follows:

- 71.994 million tons in 2019
- 50.182 million tons in 2020
- 61.250 million tons in 2021

The Black Thunder Mine LOM Plan projects mining through December 2036, at an expected mine life of 16 years. The LOM Plan projects mining from three pits at Black Thunder Mine; the North, West and South pits.

Black Thunder currently operates a fleet of four draglines and nine shovels for overburden removal and four shovels for coal removal from the three pits. The pits will typically be 200 to 230 feet wide, with pit lengths ranging from 4,310 feet to 16,906 feet in the LOM Plan. The typical pit configuration is an initial truck/shovel pass(s) for prestrip, since the draglines cannot

effectively handle the total burden. Cast blasting is normally implemented in the next pass prior to the dragline pass, and this pass sequence can require significant dozer material handling, utilizing Black Thunder Mine's remote control dozer fleet. Subsequently, the dragline handles the quantity of material for which it was designed, in the next pass. The dragline performs multiple passes typically using a modified extended bench, which results in a spoilside pass before the Main Seam coal is mined.

Mining progresses in an orderly and sequential fashion to meet the required sales tonnage and coal quality. The current mining sequence south of State Highway 450, progresses in an east to west manner. North of State Highway 450, mining advances from south to north. Recovery of coal beneath the existing rail spurs, mine facilities, and State Highway 450 is deferred to the later years of the LOM Plan in order to utilize the existing surface facilities as long as possible.

1.5 MINERAL RESERVE AND RESOURCE ESTIMATE

The Black Thunder Mine coal resources, as of December 31, 2021, are reported as in-place resources and are exclusive of reported coal reserve tons. Resources are reported in categories of Measured, Indicated and Inferred tonnage in accordance with Regulation S-K Item 1302(d), and summarized in Table 1.5-1as follows:

Table 1.5-1 In-Place Coal Resource Tonnage and Quality Estimate, as of December 31, 2021

	Average Coal		In-Place Resources (000 Tons)			Average	Raw Coal Quality (Dry Basis)					
	Area	Thickness				Stripping Ratio	Ash	Relative Density	Equilibrium Moisture	Sulfur	Volatile	Calorific Value
Seam	(Acres)	(Feet)	Measured	Indicated	Total	(BCY/T)	(%)	(Lbs/CF)	(%)	(%)	Matter	(Btu/lb)
WYODAK - Upper	1,200	13.49	25,000	-	25,000		5.1	79.87	25.61	0.55	33.07	8,950
WYODAK - Main	1,375	73.12	175,000	5,000	180,000		4.0	79.87	25.43	0.23	31.87	8,990
			200,000	5,000	205,000	4:1	4.1	79.87	25.52	0.27	32.00	8,980

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable surface mine assuming a thermal coal product realizing a sales price of $14.66 per ton FOB Mine and operating cost of $13.15 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding

The conversion of resources to reserves at the Black Thunder Mine considers the effects of projected dilution and loss of product coal quality, projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine plan that

accommodates the planned mining equipment and provides a safe work environment is also considered.

The coal reserve tonnage representing the economically viable tonnage controlled by Arch, and estimated in accordance with Regulation S-K Item 1302(e), is summarized in Table 1.5-2 as follows:

Table 1.5-2 Recoverable Coal Reserve Tonnage and Quality Estimate, as of December 31, 2021

								Raw Coal Quality (As Received)					
			Average Coal	Clean Recoverable Tons (000) Reserves			Average			Relative			[Q] Calorific
Seam	Product Quality	Area (Acres)	Thickness (Feet)	Proven	Probable	Total	Stripping Ratio (BCY/T)	Moisture (%)	Ash (%)	Density (Lbs/CF)	Sulfur (%)	Volatile Matter	Value (Btu/lb)
WYODAK - Upper	Subbituminous	3,700	12.68	55,000	-	55,000		25.84	6.05	79.87	0.65	33.11	8,890
WYODAK - Main	Subbituminous	4,590	71.75	485,000	5,000	490,000		25.79	4.58	79.87	0.26	31.99	8,910
				540,000	5,000	545,000	3.5:1	25.81	4.76	79.87	0.30	31.90	8,910

Notes:

- Raw recoverable Reserve tonnage based on mining recovery of 85 percent for surface mining the Upper split of the Wyodak Seam, and 92 percent for surface mining the Main split of the Wyodak Seam.
- Mineral Reserves estimated at a sales price of $14.66 per ton FOB Mine and operating cost of $13.15 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources

WEIR depleted LOM Plan reserve tonnage using actual mine workings through September 30, 2021 and subtracted actual production, reported by Arch, for the remainder of the year to arrive at reserves as of December 31, 2021.

1.6 ECONOMIC EVALUATION

WEIR prepared a Preliminary Feasibility Study financial model in order to assess the economic viability of the Black Thunder Mine LOM Plan. Specifically, plans were evaluated using discounted cash flow analysis, which consists of annual revenue projections for the Black Thunder Mine LOM Plan. Cash outflows such as capital, including preproduction costs, sustaining capital costs, operating costs, transportation costs, royalties, and taxes are subtracted from the inflows to produce the annual cash flow projections. No adjustments are made for inflation and all cash flows are in 2021 United States dollars. WEIR's study was conducted on an un-levered basis, excluding costs associated with any debt servicing requirements. In its assessment of Net Present Value (NPV), WEIR utilized a discount rate of 10 percent.

The Preliminary Feasibility Study financial model developed for use in this TRS was meant to evaluate the prospects of economic extraction of coal within the Black Thunder Mine resource area. This economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM Plan was outside of the scope of this engagement.

The results of WEIR's Preliminary Feasibility Study demonstrated an after-tax NPV of $512.0 million for the Black Thunder Mine LOM Plan. Key operational statistics for the LOM Plan, on an after-tax basis, are summarized in Table 1.6-1 as follows:

Table 1.6-1 Key Operating Statistics

	LOM Plan
Yards Moved (000s)	2,027,647
Clean Tons Produced (000s)	545,000
Stripping Ratio (CY/Ton)	3.75
Marketable Tons Sold (000s)	545,000
	($ Per Ton)
Coal Sales Realization	14.67
Direct Cash Costs	8.26
Other Cash Costs	4.20
Non-cash Costs	0.69
Total Cost of Sales	13.15
Profit / (Loss)	1.51
EBITDA	2.20
CAPEX	0.19

A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales price, operating cost, capital expenditures, and discount rate on the base case after-tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed.

The Black Thunder Mine NPV is most sensitive to changes in coal sales price and operating cost. It is least sensitive to changes in discount rate and capital expenditures.

1.7 ENVIRONMENTAL STUDIES AND PERMITTING REQUIREMENTS

As part of the permitting process required by the Wyoming Department of Environmental Quality (DEQ), numerous baseline studies and impact assessments were undertaken by Arch.

These baseline studies and impact assessments included in the permit are summarized as follows:

- Groundwater Inventory
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

The Black Thunder Mine has been issued mining permits and associated NPDES permits by the DEQ as shown in Table 1.7-1 as follows:

Table 1.7-1 Black Thunder Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
233	62,066.12	12/3/1974	WY0024091

The permitted area, bond amounts and reclamation liability for Permit 233 is shown in Table 1.7-2 as follows:

Table 1.7-2 Black Thunder Mine Permitted Area, Reclamation Liability, and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [(1)] ($000)	Bond Amount ($000)
233	62,066	223,000	419,100

[(1)] Represents the undiscounted cash flows to satisfy reclamation as of December 2021

Arch currently employs approximately 1,024 personnel at the Black Thunder Mine and is projected to have a maximum employment of 1,078 personnel in 2022 and decreasing in subsequent years over the Black Thunder Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

Permit No. 233 has not been cited for any permit violations since 2014, which is exceptional for a coal mining operation the size of the Black Thunder Mine.

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts are adequate and reasonable in order to obtain approvals necessary relative to the execution of the Black Thunder Mine LOM Plan.

1.8 CONCLUSIONS AND RECOMMENDATIONS

Arch has a long operating history of resource exploration, mine development, and mining operations at the Black Thunder Mine, with extensive exploration data utilizing drillholes, supporting the determination of mineral resource and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with Regulation S-K 1300 requirements. There are 205.0 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 545.0 million clean recoverable tons of underground mineable reserves within the Black Thunder Mine as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Black Thunder Mine LOM Plan, considering historical mining performance, historical and projected thermal coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring reserves and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

WEIR assessed risks associated with the economic mineability of the Black Thunder Mine to be low to moderate and adds that the majority of the risks can be kept low and/or mitigated with proper planning and monitoring of the mining operations.

WEIR recommends that any future exploration work and mineral property acquisition should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory analysis of any core hole samples.

Mine Plan

- Continue to monitor the results of the dewatering wells to minimize groundwater flows and adverse impact on highwall stability.

2.0 INTRODUCTION

2.1 REGISTRANT

WEIR was retained by Arch (NYSE: ARCH) to prepare a TRS related to Arch's currently operating Black Thunder Mine. The Black Thunder Mine is located approximately 50 miles south of Gillette, Wyoming, in Campbell County within the PRB coal producing region of the United States (see Figure 1.1-1).

2.2 TERMS OF REFERENCE AND PURPOSE

This TRS was prepared specifically for Arch's Black Thunder Mine. The Upper and Main splits of the Wyodak Seam resources at the Black Thunder Mine have been classified in accordance with SEC mining property disclosure rules under Subpart 1300 and Item 601 (96)(B)(iii) of Regulation S-K. Unless otherwise stated, all volumes, grades, distances, and currencies are expressed in United States customary units.

The accuracy of reserve and resource estimates are, in part, a function of the quality and quantity of available data at the time this report was prepared. Estimates presented herein are considered reasonable. However, they should be accepted with the understanding that with additional data and analysis available subsequent to the date of this report, the estimates may necessitate revision which may be material. Certain information set forth in this report contains "forward-looking information", including production, productivity, operating costs, capital costs, sales prices, and other assumptions. These statements are not guarantees of future performance and undue reliance should not be placed on them. The assumptions used to develop the forward-looking information and the risks that could cause the actual results to differ materially are detailed in the body of this report.

The Black Thunder Mine is a permitted surface mine that commenced production of thermal coal in the fourth quarter of 1977.

For the Black Thunder Mine, as an established producing mine, this TRS reports both mineral reserves and resources (exclusive of reserves). Supporting the assessment of the economic mineability of reported reserves and prospects of economically feasible extraction of reported resources, this report includes summary detail of a Preliminary Feasibility Study conducted relative to the Black Thunder Mine.

WEIR's evaluation of Arch's coal reserves and resources was conducted in accordance with SEC S-K 1300 definitions for Mineral Resource, Mineral Reserve and Preliminary Feasibility Study as follows:

- Mineral Resource is a concentration or occurrence of material of economic interest in or on the earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.
- Mineral Reserve is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the Qualified Person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.
- Preliminary Feasibility Study is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a Qualified Person has determined (in the case of underground mining) a preferred mining method, or (in the case of surface mining) a pit configuration, and in all cases has determined an effective method of mineral processing and an effective plan to sell the product.

2.3 SOURCES OF INFORMATION AND DATA

The primary information evaluated for this study, including but not limited to maps, plans, schematics, drawings, and discussions, was as follows:

- Geological data that was exclusively provided by Arch geology and engineering staff. The geological data includes drillhole information such as driller's logs, geologist's logs, both full and partial scans of geophysical logs, survey data, coal quality laboratory certificates, and MS Excel™ (Excel) versions of drillhole survey, lithology, and quality data. Additionally, WEIR was provided with modelled coal seam floor elevations and seam thickness contours, topography contours, and other base geological data.

- Mineral and surface ownership maps, and supplemental files were provided exclusively by Arch Land LLC, a subsidiary of Arch.
- Site visits by WEIR Qualified Persons (QPs) on August 19, 2021.
- Interviews between WEIR personnel and Arch personnel including
  - Ø President of Wyoming Operations
  - Ø Vice President of Geology & Exploration
  - Ø Director of Financial Analysis and Support
  - Ø Engineering Manager
  - Ø Sr. Engineer
- Historical production, productivity, staffing levels, operating costs, capital expenditures, and coal sales revenue provided by Arch.
- Life of Mine (LOM) projections and cost model provided by Arch.
- Health, safety, and environmental issues discussed during interviews between WEIR personnel and Arch personnel.
- Current mine permits, in addition to recent permit revisions and renewals provided by Arch.
- Current and projected mine plans, including production, productivity, operating costs, and capital expenditures required to sustain projected levels of production for the Black Thunder Mine, provided by Arch, and which were all reviewed for reasonableness by WEIR.
- Market outlook and coal sales price projections provided by Arch
- Projected reclamation costs for mine closure activities provided by Arch.

A detailed list of all data received and reviewed for this study is provided in Sections 24.0 and 25.0 of this TRS.

2.4 DETAILS OF THE PERSONAL INSPECTION OF THE PROPERTY

WEIR personnel previously visited the Black Thunder Mine on July 24, 2019. WEIR has also performed numerous annual audits of the Black Thunder Mine reserves for Arch's annual SEC 10-K filings.

WEIR initially held discussions with mine management on July 21, 2021, to review questions relative to the Black Thunder Mine's geology, mine plans and operations. The management discussions included key topics as follows:

- Geology
- Property
- Infrastructure
- Mine Plan, Production and Productivity
- Operating Costs and Capital Expenditures
- Marketing
- Environmental and Compliance
- Risks and Uncertainties

Subsequently. WEIR personnel visited the Black Thunder Mine on August 19, 2021. Areas of the mine visited included the following:

- Mine office and bathhouse
- Warehouse
- Stockpiles
- Rail Loadout
- West Pit

In addition to observance of mine infrastructure, surface facilities and mining conditions, WEIR discussed the Black Thunder Mine LOM Plan with mine management personnel.

2.5 PREVIOUS TRS

This TRS is the initial TRS to be filed related to the Black Thunder Mine.

3.0 PROPERTY DESCRIPTION

3.1 PROPERTY LOCATION

The Black Thunder Mine is located approximately 50 miles south of Gillette, Wyoming in Campbell County, within the PRB coal producing region of the United States (see Figure 1.1-1). The United States Geological Survey (USGS) 7.5-minute quadrangle map sheets, upon which the Black Thunder Mine can be found, are Hilight, Open A Ranch, Reno Reservoir, Piney Canyon NW, Teckla and Piney Canyon SW.

3.2 PROPERTY AREA

The Black Thunder Mine permit area includes approximately 62,066 acres of controlled mineral property.

The Black Thunder Mine surface facilities are located within the Black Thunder permit area, near the central area of the mid-north boundary of the permit. The surface facilities include mine administration, engineering, and operations offices, mine roads, laydown areas, ponds, crushers, rail loadouts, mine maintenance facilities, warehouse facilities, parking lots. The total disturbed area for the Black Thunder Mine surface facilities is approximately 3,230 acres. The coal, backfill, and topsoil stockpiles represent approximately 5,300 additional acres of disturbed area.

3.3 PROPERTY CONTROL

The Black Thunder Mine reserve boundary comprises approximately 62,066 acres. Within that boundary, Arch controls the Upper and Main splits of the Wyodak Seam through 18 coal leases covering approximately 62,066 acres. Table 3.3-1 describes the various property control contracts.

Table 3.3-1 Property Control

Document Type	Quantity
Agreements	44
Appurtenant	1
Grazing Lease	2
Coal Leases	25
Deeds	26
Overstrip Agreement	6
Partial Lease	1
Right of Entry	1
Surface Rights	1
Trackage Ownership	2
Water Rights	44

Each individual contract shown above may include more than one type of property control.

3.4 MINERAL CONTROL

Coal seam mineral rights are controlled by nine coal leases, six federal leases and seven state leases. All but two leases have minimum annual rental payments ranging from $480 to $18,225. All of the leases have a production royalty rate of 12.5 percent of the Gross Sales Price (GSP). The leases have a minimum royalty that must be paid annually in order to maintain the lease, with the exception of one lease, which has a one-time minimum royalty payment. Three leases have additional annual rental agreements. The details of the mineral control contracts are listed in Table 3.4-1.

Table 3.4-1 Mineral Control

Arch Land File Number	Document Type	Seams	Expiration Date
FCL-001	Federal Coal Lease	All seams leased	Upon Exhaustion
FCL-002	Federal Coal Lease	All seams leased	Upon Exhaustion
C-1	Coal Lease	All seams leased	Upon Exhaustion
SCL-001	State Coal Lease	All seams leased	Upon Exhaustion
SCL-002	State Coal Lease	All seams leased	Upon Exhaustion
SCL-003	State Coal Lease	All seams leased	Upon Exhaustion
SCL-004	State Coal Lease	All seams leased	Upon Exhaustion

Arch Land File Number	Document Type	Seams	Expiration Date
SCL-005	State Coal Lease	All seams leased	Upon Exhaustion
FCL-003	Federal Coal Lease	All seams leased	Upon Exhaustion
SCL-006	State Coal Lease	All seams leased	Upon Exhaustion
CL-2	Coal Lease Agreement	All seams leased	Upon Exhaustion
BT-270	Federal Coal Lease	All seams leased	Upon Exhaustion
FCL-004	Federal Coal Lease	All seams leased Surface mineable coal reserves in the Wyodak-Anderson coal zone. Generally contains two recoverable seams, the Upper Wyodak and the Middle Wyodak.	Upon Exhaustion
FCL-005	Federal Coal Lease	All seams leased	Upon Exhaustion
SCL-007	State Coal Lease	All seams leased	Upon Exhaustion

3.5 SIGNIFICANT PROPERTY ENCUMBRANCES

The Black Thunder Mine LOM Plan area is permitted with the Wyoming DEQ, Land Quality Division (LQD).

A list of Arch's permits is shown in Table 3.5-1, with a more detailed description of the permits discussed in Section 17.3.

Table 3.5-1 Permit List

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
233	62,066.12	12/3/1974	WY0024091

Since 2014, the Black Thunder Mine has not had a regulatory fine or violation from the Wyoming LQD.

3.6 SIGNIFICANT PROPERTY FACTORS AND RISKS

Given Arch's controlled interests at the Black Thunder Mine, which relate to property that is held, by and large, by Arch and the BLM, WEIR finds there are no significant issues affecting access to the coal interests, or the ability of Arch to execute the Black Thunder LOM Plan.

3.7 ROYALTY INTEREST

Arch, at the Black Thunder Mine, holds no royalty or similar interest in property that is owned or operated by another party.

4.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

4.1 TOPOGRAPHY, ELEVATION, AND VEGETATION

The Black Thunder property is located within the eastern flank of the Powder River Basin on the Missouri Plateau of the Northern Great Plains Province. The Powder River Basin is a topographic depression between the Big Horn Mountains on the west and the Black Hills on the east. The topography of the property is comprised of rolling and rugged hills, with 500 to 1,000 feet of vertical relief, in the northern part of the basin, and gentle plains, with up to 500 feet of relief, in the southern part. Surface elevations range from 4,000 feet above sea level in the north to 5,000 feet above sea level in the south.

Within the mine permit area, the terrain is gently rolling, except along the eastern edge of the property and to the south of Little Thunder Creek. In these two areas, the property is transected by steep-sided, irregular gullies and washes, which drain into Little Thunder Creek, forming breaks in the plateau. Elevations within the mine permit area range from approximately 4,570 feet to 5,030 feet. The surface of the mine permit area is made up of eroded shale slopes, alluvial terraces and small playas, minor sheet wash, and floodplains. Scoria (clinker) ledges occur near “burn” lines.

The Black Thunder property consists mostly of two major vegetation types. These major vegetation types are Mixed Grass Prairie (Upland Grassland) and the Big Sagebrush Shrubland.

The Mixed Grass Prairie vegetation is generally found on moderately deep to deep soils on gently rolling to flat topography. Perennial grasses are the dominant vegetative type here. Western wheatgrass (Agropyron smithii), needleandthread (Stipa comata), blue grama (Bouteloua gracilis), prairie Junegrass (Koeleria macrantha), Sandberg bluegrass (Poa secunda) and threadleaf sedge (Carex filifolia) are generally the most common species encountered. Cheatgrass (Bromus tectorum) is a common annual invasive species of grass that may be found during years favoring growth of this species.

The Big Sagebrush Shrubland plant community is found on a variety of soils on the area ranging from very poor and shallow to loamy and deep. This vegetation type is also found on a wide range of topographies from very steep and rolling to relatively flat. Perennial grasses

also dominate the Big Sagebrush Shrubland vegetation, but big sagebrush (Artemisia tridentata) is the single most common individual species. Other common perennial species on the Big Sagebrush Shrubland include needle and thread, western wheatgrass, prairie junegrass and blue grama. Annual species such as cheatgrass may also be common on the Big Sagebrush Shrubland in certain years.

4.2 PROPERTY ACCESS

The Black Thunder Mine is accessed from Interstate 90 from Gillette, Wyoming by traveling south on Wyoming State Highway 59 for 41.0 miles. Then turning east and traveling on Wyoming State Highway 450 for 9.7 miles. The mine entrance is located on the south side of the highway. The nearest town is Wright, Wyoming, which is located 1.9 miles north of Wyoming State Highway 450.

Rail transportation is provided by both the Union Pacific (UP) and Burlington Northern Santa Fe (BNSF) railroads with the main line running directly along the west side of the mine and spurs connecting to all three load outs. There is no river transportation available near the Black Thunder Mine.

The nearest airport is the Northeast Regional Airport located on Wyoming State Highway 59/ US Highway 14 on the north side of Gillette, Wyoming. Connecting flights are available from Rapid City Regional Airport and Denver International Airport.

4.3 CLIMATE AND OPERATING SEASON

The Black Thunder Mine property lies on the rolling high plains of northeastern Wyoming. The property is approximately 200 miles east-northeast of the low-level Continental Divide of southeastern Wyoming, approximately 60 miles west of the Black Hills, and approximately 70 miles east of the Big Horn Mountains. Climate in the high plains of northeastern Wyoming is influenced primarily by cold, dense air masses that flow across the Continental Divide from the west and northwest. Since there are no mountains north of the high plains region, the plains are subjected to periodic outbreaks of Arctic air masses during the autumn, winter, and spring. Each outbreak causes abrupt changes in weather such as northerly winds, dropping temperatures, and snow. During the winter, cold, dense air masses originating from the Great Basin (a large basin that lies between the Sierra Nevada and Rocky Mountain ranges) frequently drain across the low-level Continental Divide through southern Wyoming and down into the North Platte Valley. The

air accelerates to higher velocities and spreads over eastern Wyoming. Some of this air moves northeastward toward the Black Thunder Mine, however, the prevailing northwesterly, westerly, and southeasterly surface wind flows observed at the mine property are due to the channeling of drainage winds between the Big Horn Mountains and the Black Hills.

The summer climate is typical for the high plains with light to moderate surface winds and occasional violent thunderstorms. The thunderstorms generate most of the annual precipitation. Wind gusts, from the occasionally severe thunderstorms, sometimes reach 60 to 80 miles per hour (mph) and may be followed by hail. The climate of northeastern Wyoming can be classified as semi-arid since mean annual precipitation is approximately 13 inches and relative humidity is rather low, being less than 50 percent on an annual average.

The mean monthly temperature recorded at Gillette 2E, a meteorological station in the vicinity of the Black Thunder Mine, ranges from 72 degrees Fahrenheit (°F) in July to 22°F in January. The average frost-free growing season is 127 days. The average last spring freeze date, recorded at Gillette 2E is May 21, and the average first freeze date is September 25.

Although extreme weather is experienced at the Black Thunder Mine during all seasons, there is no seasonal limitation to operations at the Black Thunder Mine.

4.4 INFRASTRUCTURE

Power

Electrical power for the Black Thunder Mine is provided by Powder River Energy Corporation (PREC), through a 69 kV transmission line. PREC's average industrial price is 6.77 cents per KWH.

Water

The water used for dust suppression is obtained from the mine's own highwall dewatering program. This dewatering program is able to produce 500,000 to 800,000 gallons of water per year. Potable water for the facilities is obtained from two onsite deep-water wells. This water is treated at a flat rate of $2,485 per month. In 2021, the Black Thunder Mine used on average approximately 197,000 gallons of water per month.

Personnel

The northern Wyoming area surrounding the Black Thunder Mine has a long history of surface coal mining and attracting and hiring mining personnel with qualified skills has not been an issue. The Black Thunder Mine employed approximately 1,024 personnel, as of August 1, 2021. The hourly labor force at the Black Thunder Mine remains non-union and no change in this labor arrangement is anticipated.

Supplies

Supplies for the Black Thunder Mine are available from multiple vendors that service the coal mining industry in the PRB Region. The nearest Caterpillar mining equipment dealerships are located in Gillette and Casper, Wyoming, and there is a Komatsu mining equipment dealership, located in Gillette.

5.0 HISTORY

5.1 PREVIOUS OPERATIONS

Prior to the development of the Black Thunder Mine, there was no mining that occurred on the property. The Black Thunder Mine is a surface coal mine utilizing draglines and truck/shovel mining equipment for overburden removal. The mine was opened by Atlantic Richfield Company (ARCO) in 1977 and has been operated under Thunder Basin Coal Company, LLC since that time. In 1998, Arch Coal, Inc. purchased all of ARCO's domestic coal operations, which included the Thunder Basin Coal Company, Black Thunder Mine.

In 2004, Arch purchased the adjacent North Rochelle Mine from Triton Coal Company and merged it into Black Thunder Mine. The former North Rochelle Mine facilities and reserves were subsequently sold to Peabody Coal Company in 2006.

In 2009, Arch purchased the adjacent Jacobs Ranch Mine from Rio Tinto Coal and merged it into the Black Thunder Mine, which created a mining complex that produced 116.2 million tons of coal in 2010.

5.2 PREVIOUS EXPLORATION AND DEVELOPMENT

Exploration work conducted by ARCO included both pre-lease, Federal Exploration License drilling and post-lease development drilling. Pre-lease drilling was generally done on a one-half mile spacing, or one hole per quarter section, which corresponded with the requirements of the BLM for leasing Federal coal. Most development drilling was done two to three years ahead of mining on a nominal 600 feet spacing with alternating rows offset one-half the spacing resulting in a 45-degree rotated grid interval of 424 feet and included over 1,500 drillholes.

Exploration work conducted by the Jacobs Ranch Mine also included both pre-lease, Federal Exploration License drilling and post-lease development drilling. Pre-lease drilling was also generally done on a one-half mile spacing, or one hole per quarter section, which corresponded with the requirements of the BLM for leasing Federal coal. Most development drilling was done three to five years in advance of mining and was mostly done on a nominal 800 feet spacing, with alternating rows offset one-half of the spacing resulting in a 45-degree rotated grid interval of 565 feet and included over 2,600 drillholes.

Other exploration work conducted prior to Arch's acquisition included regional USGS reconnaissance drilling of unleased Federal coal, prior to ARCO's, at a density of one to two

holes per section and coalbed methane production drilling that was done on a density of anywhere between one and sixteen holes per section. The coalbed methane drillholes and most of the USGS drillholes were rotary drilled.

Mine facilities built by ARCO included a rail spur and loadout loop, a loadout with two 12,500-ton silos, a 100,000-ton slot storage barn, two crusher locations, a coal analysis lab, maintenance shop, warehouse, bathhouse, reclamation shop, and an administrative building.

Initial pit development was conducted with truck/shovel mining equipment, but ARCO subsequently added three draglines by the time the mine was acquired by Arch, including a Bucyrus-Erie 1300W with a 45 cubic yard bucket, a Bucyrus-Erie 1570W with a 90 cubic yard bucket, and a Bucyrus-Erie 2570WS with a 160 cubic yard bucket.

The Jacobs Ranch Mine also constructed mine facilities similar to those constructed by ARCO, however, as time progressed and mining moved farther west, these facilities, including the loadout, have been idled.

The Jacobs Ranch Mine was historically one of the larger truck/shovel mines until a Bucyrus-Erie 2570W dragline with a 121 cubic yard bucket was brought on-line in 2006.

6.0 GEOLOGICAL SETTING, MINERALIZATION, AND DEPOSIT

6.1 REGIONAL, LOCAL, AND PROPERTY GEOLOGY

6.1.1 Regional Geology

The Powder River Coal Basin, of northeastern Wyoming, lies entirely within the boundaries of the Powder River structural and topographic basin. Coal-bearing strata range in age from Upper Cretaceous in the Mesa Verde Formation to Eocene in the Wasatch Formation. The Powder River Coal Basin covers parts of Campbell, Converse, Crook, Natrona, Niobrara, Johnson, and Weston Counties and is the largest coal basin in Wyoming.

The basin is a broad asymmetric syncline bounded on the west by the Big Horn Mountains, on the east by the Black Hills, and to the south by the Casper Arch, Laramie Mountains, and the Hartville Uplift. The basin continues north into Montana where the Miles City Arch separates it from the Williston Basin.

The axis of the syncline is slightly west of the center of the basin. Flanking dips are gentle on the eastern limb (two to three degrees) but dip more steeply on the western limb. Faulting occurs in many localities, especially around the basin edge and is in association with folding. Vertical displacements can be several hundred feet. Faulting is more common on the western limb of the syncline than on the eastern limb.

Stratigraphic units of interest in the permit area, from youngest to oldest, include recent alluvial deposits, the Eocene Wasatch Formation, and the Paleocene Fort Union Formation. Locally, the strata dip two degrees to the west-southwest. There is no evidence of major faulting, or folding, within the permit area; although, localized warps and minor faults, probably compactional in nature, in the main coal seams have been indicated by exploration work and during the mining process.

An alluvial covering is present in the drainage patterns and in the slope wash areas adjacent to the drainages. The alluvial deposits are of recent age and consist of primarily unconsolidated, discontinuous lenses of clays, silts, and sands. Locally, recent stream channeling has removed portions of the coal seam with subsequent channel infilling of sediment. Varying amounts of oxidized coal are present when alluvium is in contact with the seam.

The lower Eocene Wasatch Formation consists of interbedded, lenticular clays, silty clays, sandy clays, thin, discontinuous coals, mudstones, and dirty sandstones. Correlation of individual strata is difficult due to the discontinuous and lens-like nature of the units which is inherent in fluvial deposition, e.g., channel sand deposits.

The Upper Paleocene Fort Union Formation underlies the Wasatch Formation. The Fort Union Formation consists of non-carbonaceous to highly-carbonaceous clays, mudstones, sandstones, and coal. The top of the Fort Union Formation is designated as the top of the Wyodak coal seam. The Wyodak Seam is the main coal seam, and it lies atop lensoidal clay, silt, and sand beds. The seam base is variable due to changes in the environment of deposition, from the non-coal forming environment of the sands, clays, and silts, to the fringes of the coal forming, swampy conditions in which the Wyodak coal seam was deposited.

Clinker (locally known as scoria), a baked or fused rock, is present along the coal outcrop on the eastern edge of the permit area. This fused material was formed by prehistoric burning of the Main Wyodak coal seam. Both the Wasatch and the Fort Union formations have been affected by this prehistoric burning and have contributed to the volume of baked material present. Mining conditions often deteriorate in proximity of these clinker deposits.

The mudstone is a uniformly textured material composed of 40 to 80 percent clay, and generally 5 to 40 percent silt; the remainder being sand. It is generally medium to dark gray with occasional brown and tan oxidized zones. The mudstone is basically soft to medium stiff with some extremely stiff waxy mudstone throughout much of the area. The mudstone contains some carbonaceous material and thin coal partings.

Sandstone is a major lithologic component of the overburden in the mine Area. It is generally weakly cemented with clay, but occasionally well-cemented resistant beds are encountered. Sandstone occurs in discontinuous zones interbedded with similarly discontinuous mudstone and siltstone. It is very fine to medium grained, gray to dark gray in color, with brown and tan oxidized zones. The sandstone ranges from well-graded, poorly-sorted silty sand to clean, uniform, poorly-graded material, consisting of over 80 percent sand in some instances. Sandstone overlies the coal in some areas.

Siltstone constitutes approximately 15 percent of the overburden by volume. Like the mudstone, it is uniformly textured with 20 to 55 percent silt, and generally 20 to 60 percent clay, the remainder being sand. It is light to medium gray in color and slightly more consolidated than mudstone. Like other overburden lithologic units, the siltstone is

discontinuous and occurs interbedded with mudstone and sandstone. In some areas, it overlies coal.

6.1.2 Local Geology

Regionally, the most economical coal seams are contained in the Paleocene Fort Union Formation and the Eocene Wasatch Formation. Individual seams range to greater than 100 feet in thickness. Large quantities of potentially surface-mineable coal are contained in these formations.

6.1.3 Property Geology

The economically mineable coal in Campbell County occurs within the Tongue River Member of the Fort Union Formation. The Wyodak coal seam occurs at the top of the Fort Union Formation and is overlain by the Wasatch Formation. The coal is low sulfur, low ash, and is subbituminous C in rank. Surface mineable coal deposits occur along the north-northwesterly striking subcrop of the Wyodak coal seam. The coal seam subcrops on the eastern edge of the lease and dips about two to three degrees to the west, with some slight rolling. This seam contains multiple benches or plys of coal of variable thicknesses, although in some local areas, it becomes one seam that reaches a thickness in excess of 100 feet. Across the mine permit area, the Wyodak Seam ranges in thickness from 10 feet to 100 feet, averaging approximately 70 feet.

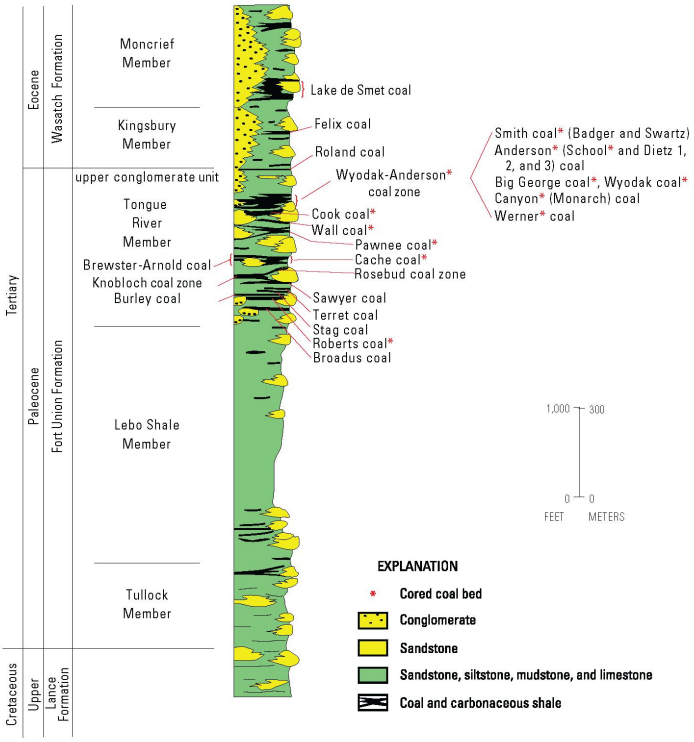
6.2 MINERAL DEPOSIT TYPE AND GEOLOGICAL MODEL

The Black Thunder Mine reserve area is a relatively flat lying sedimentary deposit of Paleocene Age. The Black Thunder Mine is actively mining a single coal seam, the Wyodak, that can be divided into multiple splits, the Upper and Main splits of the Wyodak Seam. Exploration consists of core drilling for the Upper and Main splits carried out each year in advance of mining, to refine the reserve boundary and to define limits of the mine plan. For internal purposes, Arch models the reserve using the Geovia Minex® mine planning software package, completing model updates subsequent to each phase of exploration drilling. WEIR modeled the reserves and resources using Datamine MineScape® Stratmodel geological modeling software. The WEIR model is discussed in more detail in Section 9.1.

6.3 STRATIGRAPHIC COLUMN AND CROSS SECTION

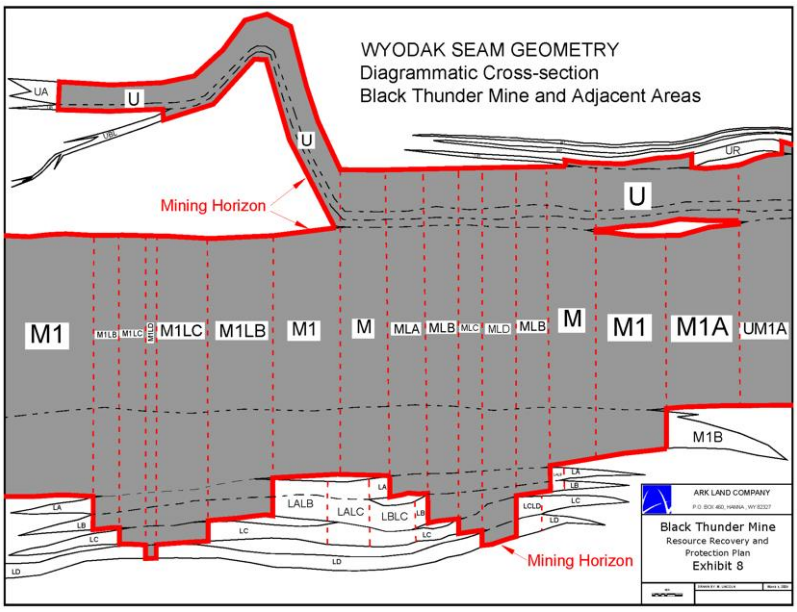
Figure 6.3-1 and Figure 6.3-2 show the stratigraphic column and the Upper and Main Wyodak splits cross section related to the Black Thunder Mine.

Figure 6.3-1 Stratigraphic Column



Source: U.S. Geological Survey Open-File Report 98-0789B-B (1998)

Figure 6.3-2 Wyodak Seam Cross Section Northwest to Southeast



Source: Arch Land Company

7.0 EXPLORATION

7.1 NON-DRILLING EXPLORATION

Drilling has served as the sole form of exploration carried out on the Black Thunder Mine property.

7.2 DRILLING

Arch's exploration activities exclusively involve drilling performed by competent contract drilling companies. Exploration drilling at Black Thunder Mine has been a two-stage approach. Initial spot core drilling is conducted on a widely spaced, one-half mile, pattern in order to delineate potential lease areas. Once the area has been leased, development drilling is conducted three to five years in advance of pit development. This drilling is generally on a 500 feet north/south grid with alternating rotary and spot core holes and is done in conjunction with dewatering endeavors. This arrangement results in a seam geometry data spacing of 500 feet and a coal quality data spacing of 1,000 feet. Drilling is conducted with rotary drilling rigs capable of 1,000 feet depths.

All holes are geophysically logged with a standard coal suite tool consisting of gamma, density, caliper, and resistivity. Geophyical logging contractors provide paper copies, .TIF files, and .LAS files.

Spot core holes are rotary drilled to a core point which is projected from the geologic computer model and may be adjusted in the field as drilling progresses. A 3-inch diameter core is then extracted in roughly 20 feet core runs by tripping pipe out of the hole for each core run.

Upon reaching the surface, the split-tube core barrel is opened, core is washed down if necessary, and the driller's reported length of core that was actually cut is compared to the measured length of core actually recovered. Total core loss for the entire seam is generally less than 2 feet. If a section of core greater than 10 feet, or less if in a critical zone, is lost, then the hole is re-drilled to recover the lost interval.

Coal sampling for the Upper split of the Wyodak Seam is in 1.0 foot increments for the top and bottom of the seam and evenly proportioned samples of 5 to 10 feet for the remainder of the seam. Sampling for the Main split of the Wyodak Seam is in 1.5 feet increments for the

top and bottom of the seam, and 10 feet increments for the remainder of the seam. All partings encountered, down to a thickness of 0.4 foot, are sampled separately.

A hole with significant lost core or crushed core can result in misleading data. Drillholes with core recovery of less than 90 percent are noted and subsequently reviewed and potentially excluded from geological and coal quality modeling. WEIR did not exclude any drillholes for poor core recovery, as all of the holes within the Black Thunder Mine area attained core recovery of at least 90 percent. During core drilling, all core samples are boxed, photographed, and stored. Roof and floor strata core samples are sent to laboratories for geotechnical strength tests. Coal seam core samples are sent to laboratories for quality analyses. Caliper, density, gamma, resistivity, and sonic downhole geophysical logs are completed as drill site and hole conditions allow. Each drillhole collar location is surveyed for accurate map coordinate and elevation data.

All original drillhole, survey, geological, geophysical, and quality data is scanned and stored on an Arch server, which is backed up nightly, and can be accessed by select Arch personnel and quickly checked against the database, the geological model, or mine mappings. The original copies are stored in an offsite warehouse.

Table 7.2-1 summarizes the database of Arch's core drilling data that is within the Black Thunder Mine LOM Plan.

Table 7.2-1 Drilling Programs

			Hole Type						
Drilling Series	Program Dates	Total Number of Drill Holes	Rotary	Core	CBM	Geophysical Logs	Geologist's Log	Driller's Log	Lab Analyis Certificates
Arch Series	2001	2	-	-	-	2	-	-	-
BR Series	1973	2	-	-	2	-	2	2	-
BT Series	2000-2020	503	226	227	-	500	285	12	277
C Series	1979-2002	2	-	1	1	2	1	-	-
D Series	2000	6	-	-	6	6	-	-	-
EC Series	1976	2	-	2	-	1	-	2	-
FED Series	1998	2	-	-	2	2	-	-	-
H Series	2000	2	-	-	2	2	-	-	-
LTC Series	2001	12	-	12	-	5	12	5	12
Numerical Series	1970-2009	155	17	138	-	152	143	7	138
R Series	1991	1	1	-	-	1	-	1	-
RENOC Series	1999	8	-	-	8	8	-	-	-
REV Series	2001	5	-	-	5	5	-	-	-
SB Series	1974	1	1	-	-	1	1	-	-
SHO Series	2006	11	-	11	-	11	11	-	11
SUN Series	Unknown	1	-	-	1	1	-	-	-
WBT Series	1989	5	-	5	-	5	5	-	5
ZIM Series	1999	1	-	-	1	1	-	-	-
		721	245	396	28	705	460	29	443

WEIR did not have direct involvement with the planning, implementation or supervision of Arch's drilling programs. However, having reviewed the details of each drilling program, WEIR finds the planning, implementation and supervision of Arch's drilling programs, with all data derived from the drilling programs, to be consistent with industry standards, and sufficient and relevant for use in the estimation of reserves and resources.

7.3 HYDROGEOLOGY

The Black Thunder Mine is situated in the southern portion of the Powder River Basin, within the Cheyenne River watershed and Upper Powder and Antelope sub-basins. The Black Thunder permit area is located on the east limb of the Powder River Structural Basin in northeastern Wyoming. The east limb of the basin dips two to three degrees to the west. The primary drainage in the Black Thunder Mine permit area is Little Thunder Creek, fed by several tributaries within the permit boundary.

Principal aquifers within the Black Thunder Mine permit area include the Fort Union and overlying Wasatch Formations. These Tertiary Age sand and mudstones occur in the upper portion of the Wasatch-Fox Hills hydrographic sequence (see Figure 6.3-2). The Wasatch-Fox Hills sequence is 1,350 feet thick in the northern part of the Powder River Basin and thickens to almost 7,000 feet in Converse County, Wyoming. On a regional basis, flow moves from peripheral recharge areas (along scoria outcrops) toward the center of the basin, primarily controlled by stratigraphy and surface water streamflow. Within the Black Thunder Mine permit area, the gradient dips gently to the west, with head elevations ranging from 4,590 to 4,680 feet.

Arch has engaged in extensive surveying to characterize site hydrogeology and to determine groundwater inventories, water quality, and potential impacts to local usage as part of its National Pollutant Discharge Elimination System (NPDES) permitting process with the Wyoming DEQ. Baseline flow and quality parameters for surface and groundwater inventory have been established and monitored as required by the Wyoming DEQ.

Water sampling methods for the Black Thunder Mine are outlined and maintained by Arch in a site-specific work practice document. Reviewed annually, this operating procedure document details sampling locations, frequency, and collection protocols, including storage, transport, delivery and required chain of custody documentation. Approved methods for field data

collection and instrument calibration are described, along with methods for creating sample splits, duplicates, and blind standards.

Samples are analyzed by independent laboratories that follow the most recent approved Environmental Protection Agency (EPA) sampling methodology and procedures. The laboratories employ internal quality control and quality assurance protocols before reporting results to Arch. Arch personnel then review the results again, as a second check for quality control and assurance, before the results are published.

Groundwater inventories, water quality data, water balance, recharge and seepage rates have been reviewed in the approved permit and current permit revisions, including hydrologic impact assessments outlining risks, monitoring program detail, and mitigation obligations. Arch's approach to obtaining and managing its surface and groundwater data for the Black Thunder Mine has been demonstrated to be adequate and aligned with regulatory requirements and standard industry practices. WEIR finds no material barriers to the continued success of the Black Thunder Mine regarding hydrologic impact or compliance.

7.4 GEOTECHNICAL DATA

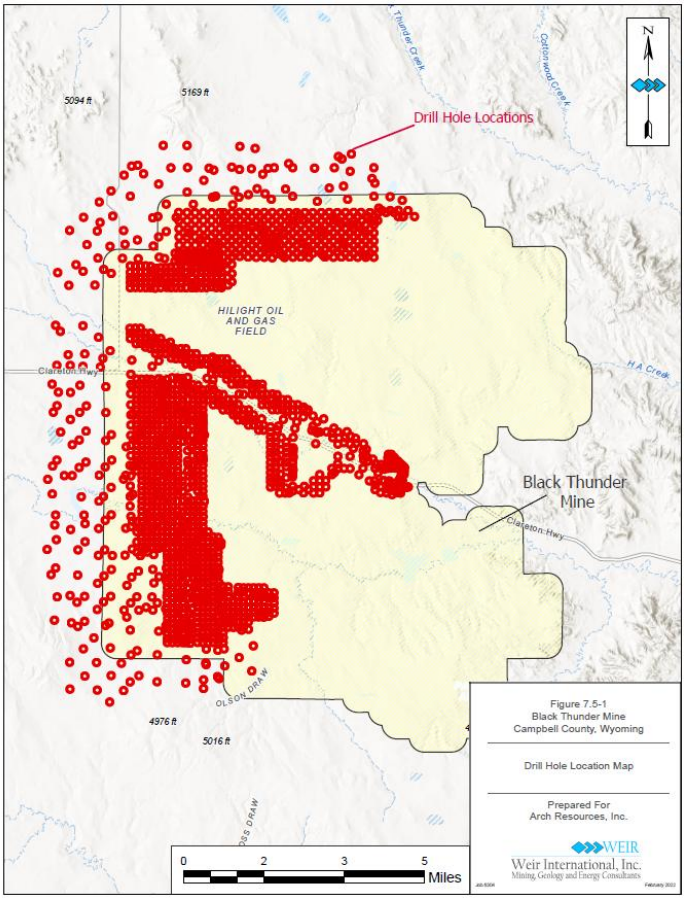
A geotechnical study of highwall stability for the North, West, and South Pits at Black Thunder Mine was completed by Barr Engineering (Minneapolis, Minnesota) in 2021 as part of a review of the mine's ground control plan (GCP). Previous geotechnical study and GCP review at Black Thunder Mine were completed in 1973, 2002, 2004, and 2009. Coring, logging, and geophysical logging of 10 boreholes were performed to characterize the lithology of the site and obtain drill core samples of the overlying sand and mudstones. Resulting samples were transported to Soil Engineering Testing (SET), located in Richfield, Minnesota, for geotechnical analysis. Analysis performed include index and soil properties, permeability, and shear strength under the appropriate American Society for Testing and Materials (ASTM) specifications.

Each cored drillhole included a companion, offset hole that was logged with downhole geophysics (e-logged) by Goodwell, Inc. located in Gillette, Wyoming, and reviewed by Pronghorn Geologic Services located in Gillette, Wyoming. Lithology for each hole was determined using gamma and density downhole data. Slope stability and seepage modeling for both drained and undrained mining conditions were completed to assess the stability of the highwall cuts in each pit.

7.5 SITE MAP AND DRILLHOLE LOCATIONS

A map showing the location of all drillholes used to estimate tonnage on the Black Thunder Mine Property is shown on Figure 7.5-1.

Figure 7.5-1 Drillhole Collar Locations



7.6 DRILLING DATA

Arch generally uses Matheson Drilling, Inc. located in Gillette, Wyoming. to drill core holes. Downhole geophysical logging is performed by Goodwell Incorporated, located in Upton, Wyoming. Coal quality analyses are currently performed by Standard Laboratories, Inc. (Standard) located in Casper, Wyoming.

8.0 SAMPLE PREPARATION, ANALYSES, AND SECURITY

8.1 SAMPLE PREPARATION METHODS AND QUALITY CONTROL

Once the target coal seam has been drilled, and immediately after logging of the core, all coal samples obtained are placed in labeled plastic core sleeves, sealed, and placed in labeled core boxes. The geologist's seam thickness measurements are checked against the geophysical logs for thickness accuracy and to confirm core recovery. The samples are coded and labeled with sample identification numbers based on drillhole id (for example, DT2001), sample sequence (A, B, C, etc.), and sample number, (1, 2, 3 etc.). (for example, DT2001A1 = first sample of first seam in drillhole DT2001.) These boxes are kept by the geologic contractor in their storage area until a sufficient load is collected, and then delivered directly to the coal analysis lab by the geologic contractor.

Samples are not split or reduced prior to delivery. The full length and diameter of the 3 inch core samples are delivered to and left at the coal analysis lab.

8.2 LABORATORY SAMPLE PREPARATION, ASSAYING, AND ANALYTICAL PROCEDURES

8.2.1 Laboratory

Coal analysis for all exploration drilling is conducted by a third-party contractor, Standard Laboratories, Inc. located in Casper, Wyoming. Standard Laboratories conducts all testing under applicable ASTM standards and is accredited by the ANSI National Accreditation Board. Sample preparation by Standard Laboratories includes crushing to suitable size and then creating an appropriate number of splits to accommodate retain samples and composite analyses samples.

All incremental samples receive an as-received short prox analysis consisting of percent moisture, percent ash, percent sulfur, and Btu/lb. After receiving the results of the short prox analysis, composite analysis increments are selected based on mining units and sent to Standard Laboratories. For most holes, these composite analyses include Full Proximate, Ash Fusion, Mineral Analysis of Ash, Equilibrium Moisture, Trace Element PPM - Mercury, and Trace Element PPM - Chlorine.

For approximately 10 percent of the holes, the composite analyses includes Full Proximate, Ultimate, Forms of Sulfur, 8-point Ash Fusion, Mineral Analysis of Ash, Water Soluable Alkalis, Hardgrove Grindability Index, Equilibrium Moisture, and Full Trace Element PPM - 27 elements.

Standard Labs is certified by ANSI National Accreditation Board and located at 1880 N Loop Ave, Casper, Wyoming 82601

8.3 QUALITY CONTROL PROCEDURES AND QUALITY ASSURANCE

Quality control procedures followed by Arch geologists are clearly defined. Arch's field geologists take defined and specific steps to protect sample integrity and to ensure core samples are always under the control of the Arch field geologist. These steps include the following:

- Field geologist to be on site whenever drilling is occurring
- Geologist's log to be created for each drillhole
- Each drillhole to be logged using geophysical methods
- Geologist to compare field geologist's logs to the e-log data
- Geologist to compare the core samples against both field geologist's logs and e-logs to confirm coal thickness
- All core to be boxed and photographed
- Quality sample sheets to be filled out, provided to a supervisor for approval and shipped to the laboratory
- Once core samples have been analyzed, field geologists to scrutinize the resulting quality data for accuracy
- Based on the homogeneity of the deposit and the consistent quality of the reserve area as evidenced from the product produced from this active mine, analytical laboratories are instructed to divide the samples and retain the second split for additional analysis should the original test report any anomalies.

8.4 SAMPLE PREPARATION, SECURITY, AND ANALYTICAL PROCEDURES ADEQUACY

Arch's procedures for quality analyses provide a full range of coal quality so that engineers and sales staff, reviewing and evaluating the data, have a complete listing of coal seam quality for each drillhole completed by Arch.

Drillhole core samples are assigned a sample ID number, and a sample label is created. The label includes drillhole ID, sample ID number, and the to and from depths of the sample. The sample is then placed in a bag with the label. The bags are sealed using zip ties or tape, which begins the chain of custody. The samples do not leave possession of the geologist, once removed from the core barrel. The samples remain with the geologist or are stored in a locked facility that only Arch geologists can access, until delivery of the samples to the contracted laboratory. The delivery of the samples is carried out within one week of drillhole completion. Once in possession of the certified laboratory, the laboratory's security procedures are followed, all in accordance with standard industry sampling preparation and analyses. After the sample has been tested, reviewed, and accepted, the disposal of the sample is in accordance with local state and EPA approved procedures.

Once satisfied that the data laboratory testing reports are accurate, the quality analyses are entered into the Arch coal database. Upon data entry completion, the modeling geologists export the data and inspects the data for variance from expected norms. If any data is outside the norm for the property, the data is checked against laboratory results to ensure proper data entry. Once proper data entry is confirmed, quality data is gridded and mapped, with any anomalies in the data mapping investigated. If anomalies are determined to be present, the anomalies are brought to the attention of the geologists, mine engineers and sales staff.

WEIR has determined the sample preparation, security and analysis procedures used for the Black Thunder Mine drillhole samples are in accordance with current industry standards for quality testing, with laboratory results suitable to use for mineral resource estimation and related geological modeling.

9.0 DATA VERIFICATION

9.1 DATA VERIFICATION PROCEDURES

WEIR reviewed and evaluated copies of all Arch drilling records for the Black Thunder Mine active reserve area, which included Excel spreadsheets, driller's log, field geologist's logs, quality results sheets from the coal quality laboratories, mine measurement tables, as well as drawing files or PDFs of the e-logs. Each drillhole within the LOM Plan was individually checked by WEIR against a copy of the driller's and/or geologist's log to confirm data accuracy.

Geological reviews performed by WEIR included:

- Drillhole lithology database comparison to geophysical logs
- Drillhole coal quality database comparison to quality certificates

After WEIR completed the precursory verifications and validations described above, the drillhole data was loaded into Datamine's MineScape® Stratmodel, a geological modeling package. MineScape provides robust error checking features during the initial data load, which include confirmations of seam continuity, total depth versus hole header file data, interval overlap, and quality sample continuity with coal seams. Once the drillhole data was loaded, a stratigraphic model was created.

Several further verifications were then possible, which include:

- Creating cross sections through the model to visually inspect if anomalies occur due to miscorrelation of seams
- Creating structural and quality contour plots to visually check for other anomalies due to faulty seam elevations or quality data entry mistakes in the drillhole database

Typical errors which may impact reserve and resource estimation relate to discrepancies in original data entry, and might include:

- Incorrect drillhole coordinates (including elevation)
- Mislabeled drillhole lithology
- Unnoticed erroneous quality analyses where duplicate analyses were not requested
- Unrecorded drillhole core loss

WEIR conducted a detailed independent geological evaluation of the data provided by Arch, designed to identify and correct errors of the nature listed above. Where errors were identified and could not be successfully resolved, it is WEIR's policy to exclude that data from the geological model. Based on its geological evaluation of data provided, WEIR did not exclude any holes within the Black Thunder Mine LOM Plan area.

9.2 DATA VERIFICATION LIMITATIONS

WEIR did not conduct an independent verification of property control surveys, nor has it independently surveyed the mining locations. Rather, WEIR relied on information compiled from maps and summaries of the owned and leased property control prepared by Arch. WEIR did not conduct a legal title investigation relative to Arch's mineral and surface rights, although there was no reason to believe, based on review of the Black Thunder Mine permit that Arch does not control (by ownership or lease) the coal or surface lands necessary to implement the Black Thunder Mine LOM Plan.

9.3 ADEQUACY OF DATA

It is WEIR's opinion that the adequacy of sample preparation, security, and analytical procedures for the drillholes that were drilled by Arch, after acquiring the property, are acceptable and meet typical industry standards. Arch employs detailed processes and procedures, described in Section 8.4, that are followed each time a core hole is to be sampled. The Arch geologist's logs for these holes contain sampling descriptions and lithologic descriptions that are sufficiently detailed to ascertain that an experienced geologist supervised the drilling and sampling. Arch coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0.

The adequacy of sample preparation, security, and analytical procedures are generally unknown for drillholes that were drilled prior to Arch acquiring the property in 1998. It is unknown if coal quality analyses were performed to ASTM standards by qualified laboratories, as detailed in Section 8.0, however, this legacy drillhole information was included because these holes, drilled prior to 1998, are within the old works and have already been mined through and have no influence within the Black Thunder LOM Plan going forward. Model verifications further support WEIR's high level of confidence that a representative, valid, and accurate drillhole database and geological model have been generated for the Black Thunder Mine that can be relied upon to accurately estimate coal resources and reserves.

10.0 MINERAL PROCESSING AND METALLURGICAL TESTING

10.1 MINERAL PROCESSING TESTING AND ANALYTICAL PROCEDURES

Mineral processing testing and analytical procedures are not applicable as no mineral processing or metallurgical testing is required at Black Thunder Mine.

After the coal is drilled and blasted, the coal is loaded by large loading shovels or front-end loaders into haul trucks for transport to crushing facilities where the coal is reduced to a final product size of two to three inches. The sized coal product is then conveyed to either the slot coal storage or the silos. As the coal travels along the belt conveyor, a sample cutter drops down intermittently, cuts a sample through the coal, and crushes it into a powder. The onsite laboratory then analyzes the samples to determine the coal quality.

10.2 MINERALIZATION SAMPLE REPRESENTATION

Coal deposits originate in flat, low-lying ground within deltas, alluvial plains, and coastal systems, and as such are a relatively homogeneous, sedimentary mineral occurrence. The deposit within the Black Thunder Mine exhibits homogeneous characteristics and does not show any substantial variations in mineralization types or styles that would adversely affect the saleable coal product. Sample data are well representative of the deposit as a whole.

10.3 ANALYTICAL LABORATORIES

The coal product that is sampled from the belt conveyor is tested at Arch's onsite laboratory to determine that the coal is meeting customer quality specifications.

10.4 RELEVANT RESULTS AND PROCESSING FACTORS

The coal is sold as a raw product, and is not processed, except for being crushed to a two to three inch top size, depending on customer requirements.

10.5 DATA ADEQUACY

Arch employs testing and analytical procedures in accordance with industry standards, which result in efficient material handling operations that provide requisite quality control to meet product quality projections. The testing performed is sufficient to support the projected saleable product quality for the Black Thunder LOM Plan.

11.0 MINERAL RESOURCE ESTIMATES

The coal resources, as of December 31, 2020, are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0 for reserve tonnage estimates). Resources are reported in categories of Measured, Indicated and Inferred tonnage, in accordance with Regulation S-K Item 1302(d)(1(iii)(A)).

11.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

Data Sources

Planimetric data was provided by Arch in AutoCAD format and primarily included base map information such as rivers, drainages, roads, mine features, and property boundaries.

The Arch drillhole data reviewed by WEIR included lithology, coal quality, and survey data, and was provided in different formats including Excel, ASCII files and PDFs. Geophysical logs, coal quality certificates, driller's logs, geologist's logs, downhole deviation data, and drillhole survey records were provided as scanned PDF files and AutoCAD drawing files. Data was provided for 1,922 drillholes, all of which are included in the structural model.

Coal quality data for 824 drillholes was provided for the Black Thunder Mine, with all 824 holes used in the quality model. Data was provided in Excel format along with quality certificates in PDF. Reasons for excluding drillhole quality samples in the modeling process included:

- Poor core recovery noted in the driller's logs.
- Quality logs that could not be matched to a drillhole.
- The quality listed for the drillhole was not relevant to the model (for example raw Btu/lb. or sulfur were supplied, but not final product Btu/lb. or sulfur). The only relevant raw values used were specific gravity and raw ash. Both are derivable from one another and have bearing on estimated in-place tons.

Geological Model

The Black Thunder Mine geological model was constructed by using seam surface grids that were created in Datamine's MineScape® Stratmodel (MineScape) geological modeling package.

Topography data was gridded using MineScape software and a grid cell size of 50 feet by 50 feet. Topographic contours from the USGS were provided by Arch in CAD format in 25-foot intervals. The contours were provided in the NAD83, Wyoming East State Plane coordinate system (FIPS 4901). The gridded USGS topography contours were compared to drillhole collars and showed that there are differences between the two sets of elevation data. On average, the drillhole collars are less than five feet above or below the USGS topography grid, with the maximum difference of 47 feet. The holes, with the greatest difference, are all outside of the Black Thunder Mine LOM Plan. The hole with the greatest difference within the LOM is approximately 17 feet. These differences are not uncommon when comparing a national data set to localized collar elevations. For this reason, WEIR has not excluded any of the drillholes that have a large elevation difference.

The seam surfaces and thicknesses were created by loading the drilling and mine measurement data into MineScape and gridding the seam intercepts using a grid cell size of 50 feet by 50 feet. The parameters used to create the model are defined in the MineScape modeling schema, which is a specification of modeling rules created for the site. The MineScape interpolators that were used in this study are common in most mine planning software packages. The Planar interpolator is a triangulation method with extrapolation enabled. Finite Element Analysis (FEM) is a widely used method for numerically solving differential equations arising in engineering and mathematical modeling. A trend surface is used in MineScape to promote conformability for the modeled seams to regional structures such as synclines, anticlines, or simply seam dip. MineScape caters to using different interpolators for thickness, roofs and floors (surfaces), and the selected trend surface as they are all modeled separately. The interpolator used for each of these items is selected on the basis of appropriateness to the data sets involved, as well as modeling experience. Stratigraphic Model Interpolators are shown in Table 11.1-1 as follows:

Table 11.1-1 Stratigraphic Model Interpolators

Interpolator	Parameter	Power/Order
Planar	Thickness	0
FEM	Surface	1
Planar	Trend	0

The coal seams that were modeled for this TRS are the Upper and Main splits of the Wyodak Seam. A summary of statistics for these drillholes are shown in Table 11.1-2.

Table 11.1-2 Drillhole Statistics

Seam	Number of Intercepts	Average Thickness (Feet)	Minimum Hole Name	Minimum Thickness (Feet)	Maximum Hole Name	Maximum Thickness (Feet)
WYODAK - Upper	1880	12.79	ARCHFED43-34	3.5	BT3794	20.8
WYODAK - Main	1880	73.77	070C2840	37.5	BT3744	73.2

The gridded structure surfaces and coal seam thicknesses were validated against drillhole information to ensure that the data was properly modeled. Inconsistencies between modeled seam surfaces and surrounding drillholes were investigated and any confirmed errors in the drillhole data or model parameters were corrected. This process was repeated until a final version of the model was developed.

Coal Quality Model

The drillhole quality data described previously in this report were used to create a raw coal quality model that included raw ash, raw Btu/lb, raw total sulfur, equilibrium moisture, volatile matter, fixed carbon and raw relative coal density.

The drillholes were verified to ensure that the seam depths used in the lithology file matched the sample depths in the quality file, with 827 drillholes found to have a fully sampled interval that included the Wyodak Upper split, and/or the Wyodak Main split. In each of these 827 drillholes, the samples were composited and added to the quality model.

Coal quality samples were loaded into MineScape and composited against the drillhole thicknesses. The composited values were then gridded using a grid cell size of 200 feet by 200 feet and the inverse distance weighted (squared) interpolator. The following quality data was modeled for the Upper and Main splits of the Wyodak Seam:

- Raw
  - Ash, Dry, weight percent
  - Calorific Value, Dry, Btu/lb
  - Total Sulfur, Dry, weight percent
  - Equilibrium Moisture, weight percent
  - Volatile Matter, Dry, weight percent
  - Fixed Carbon, Dry, weight percent
  - Hargrove Grindability Index, Dry
  - Relative Density

Quality contours were generated from the grids to check outlier values.

Additional Resource Criteria and Parameters

Based on WEIR's review and evaluation of the data and plans relative to the Black Thunder Mine, resource estimation criteria were applied to ensure reported mineral resource tonnage has a reasonable prospect for economic extraction. Resource criteria and parameters for the Black Thunder Mine are as follows:

- Resources were estimated as of December 31, 2021.
- Coal density was based on a default apparent relative density (ARD) of 1.28 grams/cubic centimeter.
- Areas where coal thickness did not meet a minimum thickness of 5.0 feet were excluded from the resource estimate.
- Tons with less than 30 feet of cover were considered to be weathered and were excluded from resource estimates.
- A maximum cut-off parting thickness of 0.75 feet for mining the Lower Splits.
- Areas not considered feasibly accessible because of geometry and location in relation to previous mine workings were excluded from resource estimates.
- Tonnage outside of current LOM Plan, but within existing property control, and meeting the criteria listed here, was classified as Resource tonnage and is reported exclusive of Reserve tonnage.
- Arch does not use a maximum Stripping Ratio cut-off.

11.2 ESTIMATES OF MINERAL RESOURCES

The coal resources, as of December 31, 2021, are reported as in-place resources and are exclusive of reported coal reserve tons (see Section 12.0). Resources are reported based on the coal resource estimate methodology described and are summarized in Table 11.2-1 as follows:

Table 11.2-1 In-Place Coal Resource Tonnage and Quality Estimate, as of December 31, 2021

	Average Coal		In-Place Resources (000 Tons)			Average	Raw Coal Quality (Dry Basis)					
								Relative	Equilibrium			Calorific
	Area	Thickness				Stripping Ratio	Ash	Density	Moisture	Sulfur	Volatile	Value
Seam	(Acres)	(Feet)	Measured	Indicated	Total	(BCY/T)	(%)	(Lbs/CF)	(%)	(%)	Matter	(Btu/lb)
WYODAK - Upper	1,200	13.49	25,000	-	25,000		5.1	79.87	25.61	0.55	33.07	8,950
WYODAK - Main	1,375	73.12	175,000	5,000	180,000		4.0	79.87	25.43	0.23	31.87	8,990
			200,000	5,000	205,000	4:1	4.1	79.87	25.52	0.27	32.00	8,980

Notes:

- Mineral Resources reported above are not Mineral Reserves and do not meet the threshold for reserve modifying factors, such as estimated economic viability, that would allow for conversion to mineral reserves. There is no certainty that any part of the Mineral Resources estimated will be converted into Mineral Reserves. Mineral Resources reported here are exclusive of Mineral Reserves.
- Resources stated as contained within a potentially economically mineable surface mine assuming a thermal coal product realizing a sales price of $14.66 per ton FOB Mine and operating cost of $13.15 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding.

11.3 TECHNICAL AND ECONOMIC FACTORS FOR DETERMINING PROSPECTS OF ECONOMIC EXTRACTION

A Preliminary Feasibility Study was conducted to assess the prospects for economic extraction of coal within the Black Thunder Mine.

The Free on Board (FOB) Mine coal sales price used in assessing the economic mineability of the Black Thunder Mine is primarily based on sales of a thermal coal product, which had an average coal sales price of $12.64 per ton in 2018 through October 2021 and is projected to average $14.66 per ton over the Black Thunder Mine LOM Plan. The sales price is further supported in Section 16.0 of this report.

Capital expenditures (including contingency) are discussed in further detail in Section 18.1 and are projected to average $0.19 per ton over the Black Thunder Mine LOM Plan, which are identical to actual capital expenditures for the Black Thunder Mine of $0.19 per ton in 2018 through October 2021.

Operating costs are discussed in further detail in Section 18.2 and are projected to average $13.15 per ton over the Black Thunder Mine LOM Plan, compared to actual Black Thunder Mine operating cost of $11.39 per ton in 2018 through October 2021.

Total projected capital expenditures and operating cost of $13.34 per ton, and the coal sales price of $14.66 per ton, provide a reasonable basis for WEIR to determine that all remaining coal has prospects of economic extraction within the Black Thunder Mine.

11.4 MINERAL RESOURCE CLASSIFICATION

Mineral Resource estimates prepared for the Black Thunder Mine are based on the SEC Regulation S-K Item 1302(d)(1(iii)(A)), which established definitions and guidance for

mineral resources, mineral reserves, and mining studies used in the United States. The definition standards relative to resources are as follows:

Mineral Resource:

Mineral resource is a concentration or occurrence of material of economic interest in or on the Earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction. A mineral resource is a reasonable estimate of mineralization, taking into account relevant factors such as cut-off grade, likely mining dimensions, location or continuity, that, with the assumed and justifiable technical and economic conditions, is likely to, in whole or in part, become economically extractable. It is not merely an inventory of all mineralization drilled or sampled.

- *Inferred mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability. Because an inferred mineral resource has the lowest level of geological confidence of all mineral resources, which prevents the application of the modifying factors in a manner useful for evaluation of economic viability, an inferred mineral resource may not be considered when assessing the economic viability of a mining project, and may not be converted to a mineral reserve.
- *Indicated mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit. Because an indicated mineral resource has a lower level of confidence than the level of confidence of a measured mineral resource, an indicated mineral resource may only be converted to a probable mineral reserve.
- *Measured mineral resource* is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The level of geological certainty associated with a measured mineral resource is sufficient to allow a Qualified Person to apply modifying factors, as defined in this section, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit. Because a measured mineral resource has a higher level of confidence than the level of confidence of either an indicated mineral

resource or an inferred mineral resource, a measured mineral resource may be converted to a proven mineral reserve or to a probable mineral reserve

.

Geostatistical methods were applied to drillhole and mine measurement coal thickness data for the Wyodak Seam at the Black Thunder Mine to develop variogram ranges (radii) used for resource classification. Figure 11.4-1 illustrates the variogram using 1,902 seam thickness measurements, both within and outside of the LOM Plan. Table 11.4-1 shows the sample count, Measured and Indicated resource ranges determined by the variogram model, and average sample spacing in feet. The theoretical ranges estimated for Measured (to 4,800 feet) and Indicated (to 14,500 feet) resources in WEIR's variographic analysis demonstrates the spatial continuity of mineable coal seam thickness in the Wyodak Seam at the Black Thunder Mine.

Figure 11.4-1 Variogram Model - Wyodak Seam Thickness

Table 11.4-1 Theoretical Variogram Ranges

Variogram	Sample Count	Measured Range (Feet)	Indicated Range (Feet)	Inferred Range (Feet)	Average Sample Spacing (Feet)	Minimum Sample Spacing (Feet)	Maximum Sample Spacing (Feet)
Black Thunder Wyodak Seam	1,902	4,800	14,500	>14,500	485	28	2,327

As depicted above, variability in drillhole thickness measurements is highly correlated with the distance between individual drillholes, in particular within the theoretical ranges for Measured and Indicated tonnage. Additionally, WEIR's generation and review of the applicable quality contours further supports the continuity of coal quality throughout the deposit.

The theoretical ranges estimated for Measured (to 4,800 feet) and Indicated (to 14,500 feet) resources in WEIR's variographic and quality analysis demonstrates the spatial continuity of mineable coal seam thickness and quality in the Wyodak Seam at the Black Thunder Mine. WEIR has a high level of geological confidence in this data and considers it sufficient to allow for the application of modifying factors to support detailed mine planning and evaluation of the economic viability of the deposit within the Measured and Indicated ranges.

WEIR has chosen to apply classification radii more conservative than the theoretical radii demonstrated above to be consistent with previous reporting for the Black Thunder Mine

deposit. Selection of more conservative classification radii only further increases confidence within the various tonnage classification categories.

Classification radii utilized by WEIR in this study are as follows:

- Measured: 0 - 1,320 feet (based on 1,902 observations informing estimate of coal thickness within this range)
- Indicated: 1,320 - 3,960 feet (based on 1,902 observations informing estimate of coal thickness within this range)
- Inferred: greater than 3,960 feet (based on 1,902 observations informing estimate of coal thickness within this range)

11.5 UNCERTAINTY IN ESTIMATES OF MINERAL RESOURCES

Mining is a high risk, capital-intensive venture and each mineral deposit is unique in its geographic, social, economic, political, environmental, and geologic aspects. At the base of any mining project is the mineral resource itself. Potential risk factors and uncertainties in the geologic data serving as the basis for deposit volume and quality estimations are significant considerations when assessing the potential success of a mining project.

Geological confidence may be considered in the framework of both the natural variability of the mineral occurrence and the uncertainty in the estimation process and data behind it. The mode of mineralization, mineral assemblage, geologic structure, and homogeneity naturally vary for each deposit. Structured variability like cyclic depositional patterns in sedimentary rock can be delineated mathematically with solutions like trend surface analysis or variography. Unstructured variability, in the distribution of igneous rock composition, for example, is more random and less predictable.

The reliability of mineral resource estimation is related to uncertainties introduced at different phases of exploration. Resources meeting criteria for Measured, Indicated, and Inferred categories are determined by the quality of modeled input data, both raw and interpreted. An exploration program comprises several stages of progressive data collection, analysis, and estimation, including:

- Geological data collection
- Geotechnical data collection
- Sampling and assaying procedures

- Bulk density determination
- Geological interpretation and modeling
- Volume and quality estimation
- Validation
- Resource classification and estimation

Error may be introduced at any phase. Data acquisition and methodologies should be properly documented and subject to regular quality control and assurance protocols at all stages, from field acquisition through resource estimation. Managing uncertainty requires frequent review of process standards, conformance, correctional action, and continuous improvement planning. Risk can be minimized with consistent exploration practices that provide transparent, backwards traceable results that ultimately deliver admissible resource estimates for tonnage and quality.

Less dense drillhole coverage in the southwestern portion of the Black Thunder Mine is a source of uncertainty, however, that uncertainty is reflected in the classification of Indicated resources versus Measured resources.

As discussed in Sections 8.0, 9.0, and 10.0, it is WEIR's opinion that Arch's methodologies of data acquisition, record-keeping, and QA/QC protocols are in accordance with Arch procedures, and are adequate and reasonable for resource estimation at the Black Thunder Mine.

In summary, WEIR has reviewed all geologic and geotechnical data inputs, collection protocols, sampling, assaying, and laboratory procedures serving as the basis for the deposit model, its interpretation, and the estimation and validation of the quantity and quality of coal resources at the Black Thunder Mine. The spatial continuity of the Upper and Main splits of the Wyodak Seam coal deposit at the Black Thunder Mine is well demonstrated by professionally developed, well maintained, quantitative and qualitative data. WEIR finds no material reason regarding geologic uncertainty that prohibits acceptably accurate estimation of mineral resources.

11.6 ADDITIONAL COMMODITIES OR MINERAL EQUIVALENT

There are no other commodities or minerals of interest within the Black Thunder Mine resource area other than the coal deposit discussed in this TRS.

11.7 RISK AND MODIFYING FACTORS

The concentration of drilling within the exclusive resource area is less dense than the rest of the Black Thunder Mine area. The resource area is a long thin area, approximately 37,000 feet by 1,000 feet, that bounds the LOM Plan to the west. Drilling within the adjacent LOM Plan reserve area make up the bulk of the data points used for resource estimation. Many of these drillholes are within 200 to 800 feet of the border between the reserve and resource areas. However, the spacing increase as you go west. The average drillhole spacing ranges from 800 to 1,300 feet, and one instance of approximately 3,000 feet. This wider spacing can decrease the confidence of structural features, including seam thickness, and top and bottom elevations. The resource area in the Black Thunder Mine is bounded by the LOM Plan in the east and by Arch's lease control boundary in the west. Additional drilling in the Black Thunder Mine resource area will increase confidence in the structural features.

Risk is also associated with the volatility of coal sales prices, and significant variations in operating cost, capital expenditures, and productivity can preclude the economic mineability of the Black Thunder Mine, at projected thermal coal sales prices.

Unforeseen changes in legislation and new industry developments could alter the performance of Arch by impacting thermal coal demand, regulation and taxes, including those aimed at reducing emissions of elements such as mercury, sulfur dioxides, nitrogen oxides, particulate matter or greenhouse gases. The emphasis on reducing emissions, is more of a concern for mines producing a thermal coal product like that produced from the Black Thunder Mine.

12.0 MINERAL RESERVE ESTIMATES

12.1 KEY ASSUMPTIONS, PARAMETERS, AND METHODS

The conversion of resources to reserves at the Black Thunder Mine considers the projected mineral prices and operating costs, regulatory compliance requirements, and mineral control to determine if the saleable coal product will be economically mineable. The design of an executable mine plan that accommodates the planned mining equipment and provides a safe work environment is also considered.

Based on the Black Thunder Mine's historical performance and projected mineral continuity, the mine design is the primary consideration, apart from mineral resource classification, whereupon resources are converted to reserves at the Black Thunder Mine.

Based on WEIR's review and evaluation of the Black Thunder Mine LOM Plan, the justification for conversion of resources to reserves was based on specific criteria. The following criteria were used to estimate reserves for the Black Thunder Mine property:

- Reserves were estimated as of December 31, 2020.
- Coal density was based on a default apparent relative density (ARD) of 1.28 grams/cubic centimeter.
- Areas where coal thickness did not meet a minimum thickness of 5.0 feet were excluded from the resource estimate.
- A maximum cut-off parting thickness of 0.75 feet for mining the Lower Splits.
- A weathering surface, of topography minus 30 feet was used to exclude potentially oxidized coal.
- Arch does not use a maximum Stripping Ratio cut-off.
- The Upper Seam splits use an average mining recovery of 85 percent, while the Main Seam splits use an average mining recovery of 92 percent.
- For mine design purposes, it is assumed that acquisition of mineral control for currently adverse areas will be successful, as it has been historically at the Black Thunder Mine. The current Black Thunder Mine LOM Plan does not have any adverse areas, however, if Arch decides to extend the LOM Plan to the north, south or west, acquisition of adverse property will be necessary.
- Arch's mineral rights for the Black Thunder Mine coal deposits supersedes the mineral rights for oil and gas wells on the property. Arch maintains the right to have the wells

plugged and mine through them. There are 10 remaining oil and gas wells within the Black Thunder Mine LOM Plan, Arch is required to compensate the well owner when the revenue stream from a well ceases. Plugging a gas well in accordance with the Mine Safety and Health Administration (MSHA) standards, in order to mine through a well, has an average cost of $175,000. Therefore, coal tonnage surrounding the oil and gas wells has been included in the reserve estimates.

- Reserves are based on a raw coal saleable product.

12.2 ESTIMATES OF MINERAL RESERVES

The coal reserves that represent the economically viable tonnage controlled by Arch, based on the coal reserve estimate methodology described and independent evaluation of the geology, are shown in Table 12.2-1 as follows:

Table 12.2-1 Recoverable Coal Reserve Tonnage and Quality Estimate as of December 31, 2021

			Average					Raw Coal Quality (As Received)					
			Coal	Clean Recoverable Tons (000)			Average			Relative			[a] Calorific
		Area	Thickness	Reserves			Stripping Ratio	Moisture	Ash	Density	Sulfur	Volatile	Value
Seam	Product Quality	(Acres)	(Feet)	Proven	Probable	Total	(BCY/T)	(%)	(%)	(Lbs/CF)	(%)	Matter	(Btu/lb)
WYODAK - Upper	Subbituminous	3,700	12.68	55,000	-	55,000		25.84	6.05	79.87	0.65	33.11	8,890
WYODAK - Main	Subbituminous	4,590	71.75	485,000	5,000	490,000		25.79	4.58	79.87	0.26	31.99	8,910
				540,000	5,000	545,000	3.5:1	25.81	4.76	79.87	0.30	31.90	8,910

Notes:

- Raw recoverable Reserve tonnage based on mining recovery of 85 percent for surface mining the Upper split of the Wyodak Seam, and 92 per cent for surface mining the Main split of the Wyodak Seam.
- Mineral Reserves estimated at a sales price of $14.66 per ton FOB Mine and operating cost of $13.15 per ton
- Numbers in the table have been rounded to reflect the accuracy of the estimate and may not sum due to rounding
- Mineral Reserves are reported exclusive of Mineral Resources

WEIR completed a validation check of its model by using the model to calculate the theoretical tonnage of areas mined in 2021 and comparing the results to the actual production tonnage in 2021. The results were within a variance of 0.03 percent for the Main split and 0.35 percent for the Upper split. The variance can be explained in part by the differing methods of calculating tons. The WEIR model used a constant 85 percent mining recovery for the Upper split of the Wyodak Seam and 92 percent mining recovery for the Main split of the Wyodak Seam. The results of the validation are shown in Table 12.2-2.

Table 12.2-2 Reserve Validation

Seam	Actual 2021 Production Tons (000)	Estimated Model Tons (000)	Variance (%)
WYODAK - Upper	6,663,104	6,640,047	-0.35
WYODAK - Main	53,641,484	53,659,147	0.03
Total	60,304,588	60,299,194	-0.01

12.3 ESTIMATES OF RESERVE CUT-OFF GRADE

Generally, the reserves mined at Black Thunder Mine are not limited by highwalls, but rather by coal quality and stripping ratio. One area that is potentially limited by future highwall advance is the western most boundaries of leases WYW150318 and WYW174596, since it includes the areas adjacent to the main-line corridor of the BNSF Class 1 railway. At this time, this coal is considered recoverable. Future engineering studies and mine development plans will refine the mineability of this coal.

Based on historical saleable coal quality, current coal sales contracts, and projected coal quality and stripping ratios modeled by WEIR, WEIR does not foresee future coal quality deviations from the present that would adversely affect the saleable coal product.

12.4 MINERAL RESERVE CLASSIFICATION

WEIR prepared the Black Thunder Mine reserve and resource estimates in accordance with SEC Item 1302(d)(1(iii)(A)) of Regulation S-K, which establishes guidance and definitions for mineral resources, mineral reserves, and mining studies used in the United States. The SEC Regulation S-K Definition Standards relative to reserves are as follows:

> *Modifying factors* are the factors that a qualified person must apply to indicated and measured mineral resources and then evaluate to establish the economic viability of mineral reserves. A qualified person must apply and evaluate modifying factors to convert measured and indicated mineral resources to proven and probable mineral reserves. These factors include but are not restricted to: Mining; processing; metallurgical; infrastructure; economic; marketing; legal; environmental compliance; plans, negotiations, or agreements with local individuals or groups; and governmental factors. The number, type and specific characteristics of the modifying factors applied will necessarily be a function of and depend upon the mineral, mine, property, or project.

A *mineral reserve* is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the qualified person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.

- *Probable mineral* reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource.
- *Proven mineral reserve* is the economically mineable part of a measured mineral resource and can only result from conversion of a measured mineral resource.

Within the extent of the LOM Plan for the Black Thunder Mine, Measured Resources were converted to Proven Reserves and Indicated Resources were converted to Probable Reserves. Within the extent of the LOM Plan for the Black Thunder Mine, Measured and Indicated Resources were converted to Probable Reserves.

12.5 COAL RESERVE QUALITY AND SALES PRICE

Coal quality for the Black Thunder Mine was determined by modeling the drillhole coal quality analyses for the LOM Plan. The average coal quality, on a dry basis, for raw coal for the Black Thunder Mine LOM Plan reserves is shown in Table 12.5-1 as follows:

Table 12.5-1 Average Reserve Quality

	Raw Coal Quality (As Received)					
Seam	Ash (%)	Relative Density (Lbs/CF)	Moisture (%)	Sulfur[2] (%)	Volatile Matter	Calorific Value (Btu/lb)
WYODAK - Upper	6.05	79.87	25.84	0.65	33.11	8,890
WYODAK - Main	4.58	79.87	25.79	0.26	31.99	8,910
	4.76	79.87	25.81	0.30	31.90	8,910

Based on historical saleable coal quality, current coal sales contracts, and projected coal quality modeled by WEIR, WEIR does not foresee future coal quality deviations from the present that would adversely affect the saleable coal product.

Based on the expected modeled coal quality, the estimated FOB Mine coal sales price throughout the Black Thunder Mine LOM Plan and in the Preliminary Feasibility Study, averages $14.66 per ton. As detailed previously, average sales price of a sub-bituminous

thermal coal from 2018 through October 2021 was $12.64 per ton and projected to average $14.66 per ton over the Black Thunder Mine LOM Plan. The coal sales price is further supported in Section 16.0 of this TRS.

12.6 RISK AND MODIFYING FACTORS

The estimate of reserve tonnage includes areas that are exclusively within the Black Thunder Mine LOM Plan. The concentration of valid drilling data points within the Black Thunder Mine are generally less than 500 feet from the next nearest data point, resulting in a high confidence of reserve continuity and extent. All reserves within the Black Thunder Mine LOM Plan are within the Proven and Probable classifications determined using the geostatistics variographic study discussed in Section 12.4-1.

Due to the relatively simple geology in the area, and the relatively high continuity (both structure and quality) of the coal within the Black Thunder Mine LOM Plan, geologic uncertainties do not appear to pose a significant risk to mine development.

The Black Thunder Mine has an excellent safety record and maintains diligent regulatory compliance. Workforce census has been and is expected to remain stable. The primary mining equipment is well-maintained and has sufficient capability to attain projected levels of productivity and production. This further contributes to Black Thunder Mine being a relatively low risk operation.

Coal recovery is an important aspect in assessing the economic viability of a mine. Based on Arch's historical extraction rates of the surface mine plan, WEIR does not anticipate significant deviation of coal recovery throughout the Black Thunder Mine LOM Plan. WEIR utilized a weighted average mining recovery of 85 percent for the Black Thunder Mine in its estimation of recoverable reserves for the Upper split of the Wyodak Seam, and a mining recovery of 92 percent for the Black Thunder Mine in its estimation of recoverable reserves for the Main split of the Wyodak Seam.

Risk is also associated with volatility of coal market prices. Even significant variations in operating cost, capital expenditures, and productivity would not likely preclude the economic mineability of the Black Thunder Mine, at the projected thermal coal sales price.

13.0 MINING METHODS

The mining method at the Black Thunder Mine is surface mining utilizing draglines and truck/shovel mining equipment. The surface mining method has been successfully utilized in the Powder River Basin since the 1970s, and in other coal producing regions of the United States.

The Black Thunder Mine is mining the Upper and Main splits of the Wyodak Seam and parting interval within the seam utilizing draglines, shovels, front-end loaders, trucks, dozers, or scrapers in three long pits (see Figure 13.5-1).

13.1 GEOTECHNICAL AND HYDROLOGICAL MODELS

13.1.1 Geotechnical Model

Relative to highwall stability, the Black Thunder Mine pit geometry is based on the Simplified Bishop Method of analysis. This method implements rock quality strength parameters that are measured from continuous core samples as input and resulting in a factor of safety for the designed pit geometry. Continuous cores are drilled at locations intended to maintain the integrity of the geological model specifically regarding burden versus coal. As an integral part of this design, and as per MSHA requirements, the Black Thunder Mine maintains highwall safety benches that are a minimum of 40 feet in width, generally 55 feet per 100 vertical feet of highwall. All prestrip benches are also included in this pit geometry design. The Black Thunder Mine maintains, through adherence to the Simplified Bishop Method, a slope stability safety factor of 1.3 or greater. The stability models indicated that the factor of safety for the North Pit, West Pit and South Pit was greater than 1.35.

Black Thunder has an MSHA-approved Ground Control Plan that is based on the above-mentioned parameters. This Ground Control Plan is detailed in the Black Thunder Wyoming DEQ permit. Compliance with the plan is monitored by the Wyoming DEQ and the MSHA on a continuing basis to help ensure miner safety. Any corrections to the Ground Control Plan are required to be promptly submitted to the Wyoming DEQ and the MSHA for approval. However, this is rare, due mostly to the basic conservative nature of current pit design. To-date, there have been no significant slope failures at the Black Thunder Mine, although there was a slab failure in 2002 that was associated with sub-vertical jointing and likely related to water seepage from a thick sand channel.

13.1.2 Hydrogeological Model

Based on the geotechnical study conducted by Barr Engineering (Barr), groundwater problems are typically associated with loose sands observed in weaker, less cemented zones of sandstone. Groundwater flow rates are estimated by drillers during exploration drilling campaigns using measuring buckets or estimated based on experience at the site. Greater water flows were observed at higher elevations, within the sandstone, of the West Pit. As noted in the Barr study, the Black Thunder Mine has developed a series of dewatering wells, which have proven to be successful to mitigate risk related to highwall stability.

Potential concerns related to groundwater were noted in a feasibility study conducted in 1973, where groundwater levels were recorded at 26 to 36 feet below ground surface, though the location of these measurements is not known. Perched groundwater conditions have been described at the mine in prior studies, with an upper coal seam noted as a confined aquifer. These perched conditions were observed to occur in saturated “paleochannel sands” (also known as “water sands”), which have caused local slabbing failures. Dewatering was discussed as the most effective mitigation measure in a study by Calder & Workman in 1994. In general, the sand is very hard when dry, but becomes uncemented and may flow when wet or when shot.

Black Thunder performs dewatering of the overburden, as needed, prior to development of dragline highwalls, through installation of dewatering wells. In general, this is done when holes with greater than 20 gpm of water flow are encountered while performing exploration drilling in advance of the highwall development. The exploration holes are spaced at 500-feet intervals, with dewatering holes spaced at 250-feet intervals along a section line parallel to the pit, with section lines spaced 500 feet apart (perpendicular to the pit). The Black Thunder Mine reported that there are over 100 dewatering wells at the mine site with most of these wells located to support mining the West Pit.

When less than 20 gpm of water inflow is encountered while drilling, the water is generally controlled in the pit. Diversion ditches and water impoundments are created to manage surface water in the mine pits.

The Barr study reported that dewatering efforts have been observed to be effective, especially in the northern part of the West Pit. The Black Thunder Mine has observed lower water levels and less groundwater inflow from the West Pit highwall. Some entire sand units were

previously saturated, but excavation as deep as 70 feet has been attained before water is observed.

13.1.3 Other Mine Design and Planning Parameters

The Black Thunder Mine currently operates a fleet of four draglines and nine shovels for overburden removal and four shovels for coal removal from three pits. The shovels develop a series of benches that range from 50 to 100 feet to prepare a bench for the draglines. A fleet of seven diesel-powered drills create 12-1/4-inch boreholes at a 60 degree angle for cast-blasting the overburden 150 feet above the coal. The draglines remove the overburden above the coal from a bench created by the dozers, after the cast-blast. After the overburden is removed by the draglines, the coal shovels load the coal into trucks for delivery to overland belt conveyors that transport the coal to one of the three rail loadouts.

Mining progresses in an orderly and sequential fashion to meet the required sales production and coal quality. The current mining sequence south of State Highway 450, progresses in an east to west manner. North of State Highway 450, mining advances from south to north. Recovery of the coal beneath the existing rail spurs, mine facilities, and State Highway 450 is deferred to the later years of the LOM Plan in order to utilize the existing surface facilities as long as possible.

13.2 PRODUCTION, MINE LIFE, DIMENSIONS, DILUTION, AND RECOVERY

13.2.1 Production Rates

Actual yards moved, tons stripped and produced, and stripping ratio achieved by the Black Thunder Mine for 2018 through September 2021 are shown in Table 13.3.1-1 as follows:

Table 13.2.1-1 Black Thunder Mine Historical Yards Moved, Tons Stripped and Produced, and Stripping Ratio

	2018	2019	2020	2021 [(1)]	Average
Yards Moved (000s)	280,839	259,386	210,297	176,915	231,859
Tons Stripped (000s)	69,689	74,644	57,687	48,625	62,661
Marketable Tons Produced (000s)	71,123	71,994	50,182	61,250	63,637
Stripping Ratio (CY/Ton)	4.03	3.47	3.65	3.64	3.70

[(1)] Actual through September

Arch's projected yards moved, saleable coal production, and stripping ratio for the Black Thunder Mine LOM Plan are shown in Table 13.2.1-2 as follows:

Table 13.2.1-2 Black Thunder Mine LOM Plan Projected Yards Moved, Tons Stripped and Produced, and Stripping Ratio

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total
Yards Moved (million)	177	316	275	206	238	211	136	136	126	126	64	60	55	47	47	37	2,258
Tons Stripped (million)	49	64	52	51	43	42	40	40	37	37	34	32	29	25	25	20	618
Tons Produced (million)	61	65	50	50	45	45	40	40	37	37	34	32	29	25	25	20	635
Stripping Ratio (CY/ton)	3.64	4.97	5.34	4.06	5.60	4.97	3.41	3.41	3.41	3.41	1.89	1.89	1.89	1.89	1.89	1.89	3.65

13.2.2 Expected Mine Life

The Black Thunder Mine LOM Plan projects mining through December 2036, with expected mine life of 16 years (see Figure 13.5-1).

13.2.3 Mine Design Dimensions

The Black Thunder LOM Plan projects mining from three pits, North, West, and South, through 2036.

The pits are typically 200 to 230 feet wide, with pit lengths ranging from 4,310 feet to 16,906 feet in the LOM Plan. The typical pit configuration is an initial truck/shovel pass for prestrip, since the draglines cannot handle the total depth of overburden. In some areas, coal (Wyodak Rider seams) is encountered in the prestrip and where quality is acceptable, it is mined. Most of the overburden is blasted, although there are some unconsolidated areas where blasting is not required.

Cast blasting is normally implemented in the next pass; prior to the dragline pass, and this pass sequence can require significant dozer material handling, utilizing Black Thunder Mine's remote control dozer fleet. Subsequently, the dragline takes the quantity of material for which it was designed in the next pass. The dragline performs multiple passes typically using a modified extended bench, which results in a spoilside pass before the Main split coal is mined.

There are some areas where leader seams are encountered below the Main split with minimal parting thicknesses. Partings above 0.75 foot in thickness are removed with truck/shovel equipment, and the next seam below is mined. Partings are generally ripped versus blasted since the partings are relatively thin.

All coal is recovered using truck/shovel mining equipment. Since seam thickness can be more than 100 feet, multiple coal benches may be required. Coal is excavated without blasting at the mine.

Based on shovel size (mostly BE495s), all shovel benches are generally designed to ensure the safety of the shovel and truck operators. The mine uses typical spoilside ramps (6 to 8 percent), spaced strategically to help coordinate stripping operations with coal recovery. Draglines do not use these ramps to switch from spoilside to highwall side stripping. Pit bridges are commonly implemented to shorten hauls from prestrip to spoilside stripping, with these bridges part of the dragline pass design. Typically, no highwall ramps are used as the existing pits are too deep. However, highwall ramps may be used in some of the shallower prestrip areas for stockpiling suitable topsoil material.

All haulage, both coal and burden, is performed by large off-highway end dump trucks, typically 240 to 400 ton capacity. Some smaller haul trucks are used in a utility capacity for activities such as reclamation, site construction, or drainage control work.

The projected mining for the LOM Plan is shown on Figure 13.5-1.

13.2.4 Mining Dilution

Due to the thickness of the coal seam, there is no measurable dilution to the saleable coal product.

13.2.5 Mining Recovery

Mining recovery is estimated to range from 85 to 92 percent. The typical coal loss factors for the Black Thunder Mine are described below.

Uneconomic Coal Loss

Weathered, lignitic, smoldering, or poor quality coal that will not meet current contract specifications is considered uneconomic. This coal cannot be effectively blended, therefore, it is typically dumped into a waste pile and buried. The truck loads dumped into waste piles are recorded and the associated coal loss is estimated. Coal that becomes diluted to the point of becoming uneconomical from mining conditions, such as highwall or spoil failures, is accounted for as a loss in the recovery factor. Uneconomic coal near the burn line is usually left in place and is not considered recoverable coal.

Cast Blast and Scalping Loss

When a cast blast occurs, a portion of the coal seam may be fragmented and become mixed with the overburden material. As the mining operation progresses across the pit, the top of coal and a portion of the coal edge is exposed and cleaned by scalping a minimal layer off of the top. This process disposes of the coal/overburden mixture created from the cast. Since the coal that is mixed with overburden is not recoverable it is considered lost coal related to mining recovery.

Coal Fenders

The primary purposes for leaving coal fenders is for spoil stability, safety, and dilution control. Coal fenders are more likely at pit entrances and where spoil or highwall failure is anticipated to occur. In most cases, efforts are made to recover coal fenders to the greatest extent possible, as the loading equipment retreats from a pit. Any portions of unrecovered coal fenders remaining in the pit will be reflected in the mining recovery factor.

Boxcuts

Occasionally, boxcuts will be developed along previously mined areas. To limit coal loss at these boundaries, the Black Thunder Mine plans to widen such boxcuts to enhance mining recovery, to accommodate equipment operations, and to assist dewatering activities. In the event over-stripping and dewatering does not mitigate a backfill slough or ground water inundation, the Black Thunder Mine will document low wall material problems, coal loss, and the corrective action taken.

Floor Loss

Generally, the coal separates at the contact with underlying floor materials. Every effort is made to follow this interface closely. This process can be complicated, causing coal losses due to adverse seam geometry, seam characteristics, runoff and groundwater on the pit floor, and timing of coal extraction. On occasion, the floor material is so poor that some coal must be left to provide safe underfoot conditions for loading and hauling equipment. Coal left in the pit floor cannot be recovered and is reflected as a loss in the mining recovery factor.

Other Mining Losses

During the normal mining process other coal losses can occur that are difficult to quantify. Such coal losses relate to discrepancies between the actual conditions and the geological model, blasting, transportation, and spontaneous combustion. Although nearly impossible to quantify individually, all of these losses are accounted for in the mining recovery factor.

13.3 DEVELOPMENT AND RECLAMATION REQUIREMENTS

13.3.1 Surface Development Requirements

The Black Thunder Mine is an active mine and most development work has already been completed. As the mine expands, future development will be required for extension of haulroads, relocation of gas pipelines and a 69kV powerline, and relocation of the road and railroad track in the central area of the property to allow coal removal beneath.

13.3.2 Reclamation (Backfilling) Requirements

Reclamation of the mined surface areas will follow coal extraction in accordance with plans included in the current Wyoming DEQ Land Quality Permit. The land will be graded to blend with existing topographic features. Drainage systems will be reestablished. Some internally drained areas (playas) will be created to replace those existing in the pre-mine landscape. Contoured surfaces will be dressed with topsoil and planted to a variety of grasses, forbs, and shrubs.

13.4 MINING EQUIPMENT AND PERSONNEL

13.4.1 Mining Equipment

The overburden and coal removal are conducted at the three pits utilizing surface mining equipment. The Black Thunder Mine is utilizing the following industry standard surface mining equipment as shown in Table 13.4-1.

Table 13.4.1-1 Mining Equipment

Draglines

No.	Manufacturer	Model	(CY)	Material
1	Bucyrus	2570WS	164	Overburden
1	Bucyrus	2570WS	165	Overburden
1	Bucyrus	2570WS	166	Overburden
1	Bucyrus	1570WS	167	Overburden
1	Marion	8750	168	Overburden
1	Bucyrus	1300WS	169	Overburden
6				

Shovels

No.	Manufacturer	Model	Bucket (CY)	Material
3	P&H	2300	50	Coal
2	P&H	2800	65	Coal
4	P&H	2800	36	Overburden
3	Bucyrus	495HR	84	Overburden
1	Bucyrus	495B	53	Overburden
1	Bucyrus	495B	84	Coal
3	P&H	4100XPB	68	Overburden
3	P&H	4100	53	Overburden
1	Marion	351M	84	Coal
21				

Haulage Fleet

No.	Manufacturer	Model	Payload (Tons)
37	Komatsu	830E	240
14	Caterpillar	793C	255
32	Caterpillar	793D	255
1	Caterpillar	793F	255
17	Komatsu	930E	320
16	Caterpillar	795F	360
2	Caterpillar	798	400
119			

The mining equipment used at the Black Thunder Mine is capable of operating at the pit widths and lengths projected to be mined. No changes are planned for the type of mining equipment to be used throughout the Black Thunder Mine LOM Plan.

13.4.2 Staffing

The Black Thunder Mine staffing is summarized in Table 13.4.2-1 as follows:

Table 13.4.2-1 Current Staffing

	Total
Black Thunder Mine	
Salary	69
Hourly	910
	979
Support Staff	
Salary	30
Hourly	1
	31
Total Staffing	
Salary	99
Hourly	911
	1,010

Note: Staffing as of January 2022

The Black Thunder Mine is scheduled to produce coal two production shifts each day. Four rotating crews work 12 hours shifts per day, seven days a week, 365 days a year. Facility maintenance is usually scheduled for 12 to 18 hours per month per facility. There is no idle time for loading trains since trains are diverted to the loadout facility that is operating. Hourly personnel are not affiliated with any union, with no changes in that structure anticipated in the near term.

The actual and projected staffing for the Black Thunder Mine LOM Plan are shown in Table 13.4.2-2 as follows:

Table 13.4.2-2 LOM Plan Staffing

	Salary	Hourly	Total
Current[(1)]	96	816	912
2022	99	979	1,078
2023	99	856	955
2024	99	852	951
2025	99	764	863
2026	99	760	859
2027	79	605	683
2028	79	605	683
2029	73	559	632
2030	73	559	632
2031	52	399	451
2032	49	376	425
2033	44	341	385
2034	38	294	332
2035	38	294	332
2036	30	229	259

[(1)] As of August 2021.

Staffing levels will decrease as production declines through the LOM Plan.

Most of the mine employees live nearby in Wright or Gillette, Wyoming. Arch has had no major issues hiring and retaining qualified candidates for open positions and relies considerably on employee referrals.

Mine Safety

An industry standard for safety performance is the Non-Fatal Days Lost (NFDL) Incidence Rate, which is determined by the number of lost time injuries multiplied by 200,000 divided by the manhours worked.

The Black Thunder Mine manhours worked, NFDL injuries, and NFDL Incidence Rate for 2018 through Third Quarter 202, compared to the national average NFDL Incidence Rate for United States underground coal mines are shown in Table 13.4.2-3 as follows:

Table 13.4.2-3 Black Thunder Mine Manhours Worked, NFDL Injuries and NFDL Incidence Rate

	Manhours Worked	NFDL Injuries		NFDL Incidence Rate	
		Black Thunder	Contractor	Black Thunder	National Average
2018	2,394,618	2	3	0.17	0.77
2019	2,496,061	5	1	0.40	0.78
2020	2,057,547	1	2	0.10	0.79
2021 [(1)]	1,376,492	3	1	0.44	

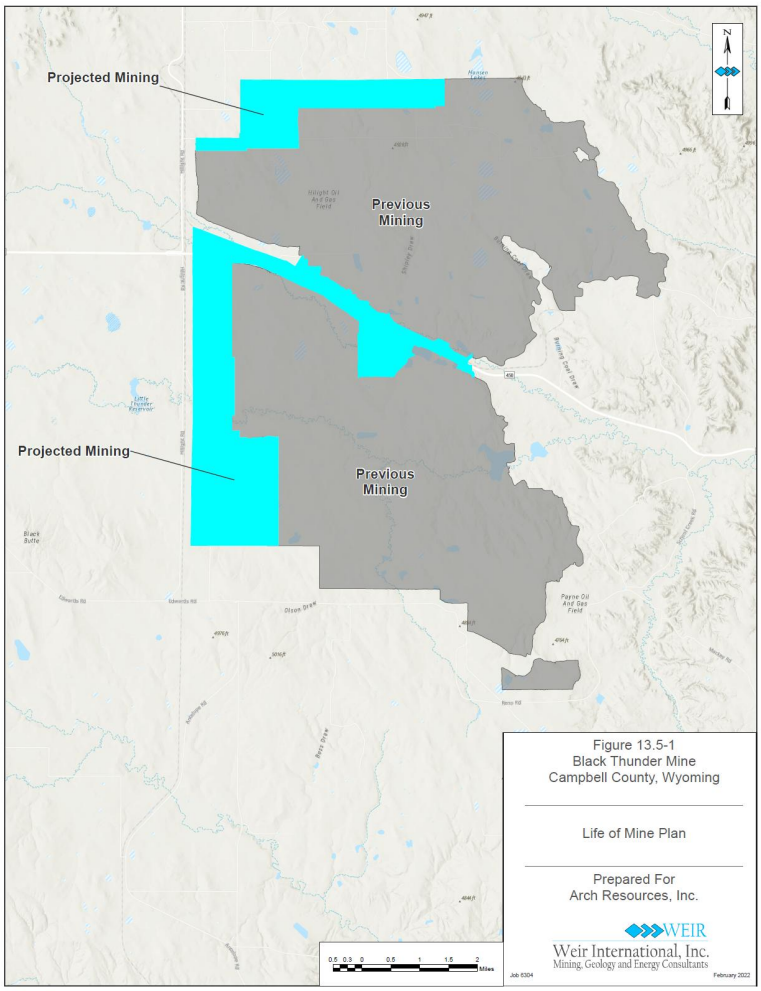
[(1)] As of Third Quarter YTD

The Black Thunder Mine NFDL Incidence Rate was significantly lower than the national average from 2018 through 2020. Despite the better than average NFDL Incidence Rate, the Black Thunder Mine did suffer a fatality on July 21, 2021 when a millwright drove the pins out of a 200-ton crane boom to change out a section and the boom fell on the employee. The Black Thunder Mine received the Sentinels of Safety Award, an industry accolade, for Plant Operations. The Black Thunder Mine recently completed a full year of operation, a total of more than 2 million manhours, without a lost time incident.

13.5 LIFE OF MINE PLAN MAP

The projected mining for the Black Thunder Mine LOM Plan is shown on Figure 13.5-1.

Figure 13.5-1 Life of Mine Plan



14.0 PROCESSING AND RECOVERY METHODS

14.1 MATERIAL HANDLING PROCESS AND FLOWSHEET

The Black Thunder Mine material handling facilities receives coal from the Primary and 5 West crushing and conveying systems. The coal transported from the pit to the Primary crushing and conveying system is dumped into one of two dump hopper/crushing stations. Each system employs a McLanahan single roll crusher that reduces the coal to a nominal minus three-inch size. Once sized, a 72-inch-wide belt conveyor transports the coal to the train loadout facility. The coal transported from the pit to the 5 West crushing and conveying system is dumped into a single dump hopper/crushing station. This system employs a two stage McLanahan triple roll crusher that reduces the coal to a nominal minus three-inch size. Once sized, a 72-inch-wide belt conveyor transports the coal to a transfer tower/chute where it is allocated to either the silos or the slot storage.

At the Black Thunder Mine Central facility, there are two, 12,500-ton capacity storage silos and slot coal storage with a design capacity of 100,000 tons. Coal that is stored in slot storage can be directed for shipment as needed. Two trains can be loaded simultaneously with the use of dual rail loops and loadout facilities. The loadout on the outer loop is capable of flood-loading trains at a rate of 5,000 tons per hour, while the silos on the inner loop are capable of flood-loading trains at a rate of 11,000 tons per hour. Batch scales have been installed at both the train loadouts and the silos. The Black Thunder Mine has a total of two track scales and five batch weigh scales.

The Black Thunder Mine West facility receives coal from the 6-North crushing and conveying system. The coal transported from the pit is dumped into a single dump hopper/crusher station. This system employs a two stage McLanahan triple roll crusher that reduces the coal to a nominal minus three-inch size. Once sized, a 72-inch-wide belt conveyor transports the coal to the Black Thunder West loadout.

At the West loadout facility, coal is directed into two, 17,500 ton capacity storage silos. Coal in the storage silos is then flood-loaded directly into railcars. There is a track scale located before the loadout as well as four batch weigh scales, which are used to measure coal loaded into railcars.

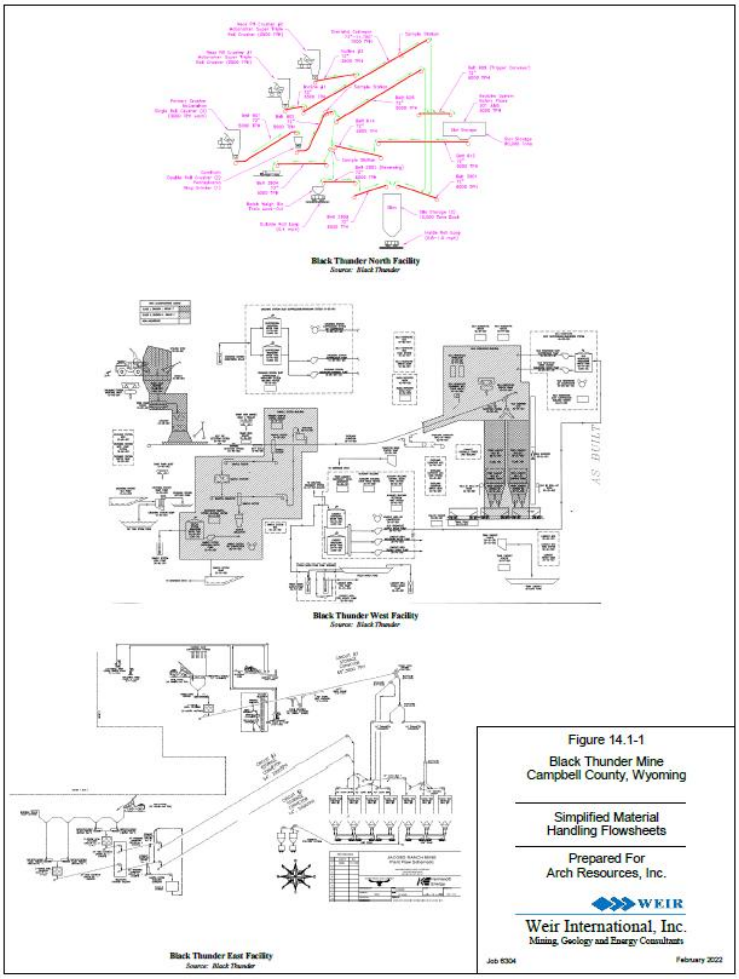
The Black Thunder Mine East facility, which is currently idle, receives coal from the Circuit 3 and Circuit 4 crushing and conveying systems. The coal transported from the pit to Circuit 3 is dumped into a single dump hopper/crushing station. This system employs a two stage McLanahan Triple roll crusher that reduces the coal to a nominal minus three-inch size. Once sized, a 60-inch-wide belt conveyor transports the coal to any of the silos, except for silos 1 and 2. The coal transported from the pit to Circuit 4 is dumped into a dual dump hopper/crushing station. This system employs a Stamler feeder breaker and a single stage Gunlock crusher that reduces the coal to a nominal minus three-inch size. Once sized, a 72-inch-wide belt conveyor transports the coal to an 84-inch-wide belt conveyor, which transports the coal to a 170 ton surge bin. There the coal is separated onto two different 54-inch-wide belt conveyors, which direct the coal to any one of the seven silos.

At the Black Thunder Mine East facility, there are seven, 14,000 ton capacity coal storage silos. The loadout facility contains two concentric rail loops, with the silos capable of flood-loading over each rail loop. Four of the silos are located over the outer loop, while the other three silos are located over the inner loop. For each loop, there is a track scale located before the loadout and there is a track scale exiting the loadout. Each loop also contains a batch weigh scale. The Black Thunder Mine East facility has a total of four track scales and two batch weigh scales.

Shipped coal is weighed using batch scales, to an accuracy of 0.25 percent, that are certified semi-annually by contractors approved by the state of Wyoming. If the batch scales should fail, a certified track scale, used to tare weigh the rail cars, can be used to measure the gross weight of the coal. The track scale is certified by contractors approved by the state of Wyoming annually and has an accuracy of 0.50 percent. Certifications for the batch scales and track scales are available for inspection at the plant administrative offices.

A simplified flowsheet for the Black Thunder material handling systems is shown on Figure 14.1-1.

Figure 14.1-1 Simplified Material Handling Flowsheets



14.2 MATERIAL HANDLING SYSTEM DESIGN, EQUIPMENT CHARACTERISTICS, AND SPECIFICATIONS

Since coal from the Black Thunder Mine coal is exclusively sold as a direct shipped ROM thermal product, there is no coal processing that is performed, aside from primary crushing. ROM coal from the pit is crushed to minus two to three inches, depending on customer requirements, before transfer to rail loading facilities.

Total storage capacity of saleable coal at the Black Thunder Mine is 158,000 tons in 11 silos and 100,000 tons in a slot coal storage facility. The stored coal is loaded into railcars from four loadouts: the Central Loadout with 1.25-hour train loading time, the Central Batch Loadout with a 3.5-hour train loading time, the East Loadout with a 1.25-hour train loading time, and the West Loadout with a 1.25-hour train loading time.

14.3 ENERGY, WATER, PROCESS MATERIALS, AND PERSONNEL REQUIREMENTS

The material handling systems require approximately 4.6 million kilowatt-hours of electricity per month. Water requirements are approximately 500,000 to 800,000 gallons per year for dust suppression.

Personnel requirements to operate the material handling and loadout facilities total 11 salary and 67 hourly employees in four rotating crews to provide operation of the facilities 24 hours per day, seven days per week.

15.0 INFRASTRUCTURE

15.1 ROADS

Access to the Black Thunder Mine property is from State Highway 450 (Clareton Highway), east of the town of Wright in Campbell County, Wyoming. The nearest cities are Wright, Wyoming to the east and Gillette, Wyoming to the north. Wright is located approximately 12 miles east of the Black Thunder Mine and Gillette is located approximately 50 miles north of the Black Thunder Mine.

15.2 RAIL

The Black Thunder Mine transports saleable ROM coal via the BNSF or UP railroads.

15.3 POWER

Electrical power for the Black Thunder Mine is provided by Powder River Energy Corporation (PREC), through a 69 kV transmission line. PREC's average industrial price is 6.77 cents per KWH.

15.4 WATER

The water used for dust suppression is obtained from the mine's own highwall dewatering program, capable of 500,000 to 800,000 gallons per year. Potable water for the facilities is obtained from two onsite deep-water wells. This water is treated at a flat rate of $2,485 per month. In 2021, the Black Thunder Mine's average water usage was approximately 197,000 gallons per month.

15.5 PIPELINES

There are several oil and gas pipelines within the Black Thunder Mine boundary. These will need to be purchased and either relocated or abandoned.

There is no natural gas service to any of the mine facilities.

15.6 PORT FACILITIES, DAMS, AND REFUSE DISPOSAL

Port Facilities

Arch primarily ships the Black Thunder Mine thermal coal directly to power plants by railroad. For its coal export shipments, Arch transports coal either by the BNSF for coal shipped through Westshore Terminals in Vancouver, Canada, or by the UP for coal shipment through Houston Bulk Terminal.

Westshore Terminals has onsite storage capacity of 2.2 million tons and an annual throughput capacity of 36.4 million tons. Ships can be loaded at a peak loading rate of 7,700 tons per hour.

The Houston Bulk Terminal is a coal terminal owned by the Port of Houston and operated by Kinder Morgan Energy Partners in Houston, Texas. The terminal has onsite storage capacity of 600,000 tons and an annual capacity of 5.25 million tons and handles both coal and petcoke. It is served by both the UP and BNSF railroads.

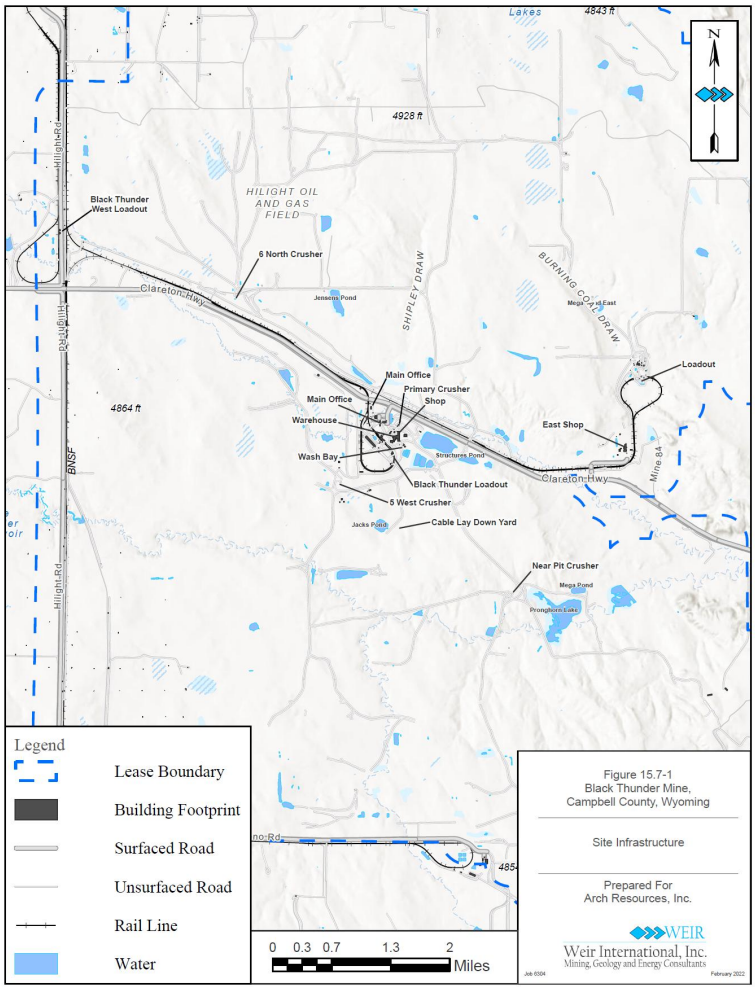
Dams and Refuse Disposal

The Black Thunder Mine does not have a slurry impoundment or refuse disposal area, since there is no coal processing required to create a saleable coal product.

15.7 MAP OF INFRASTRUCTURE

The Black Thunder Mine infrastructure is shown on Figure 15.7-1.

Figure 15.7-1 Mine Infrastructure



16.0 MARKET STUDIES

16.1 MARKETS

The Black Thunder Mine produces and sells a thermal coal product. Historically, the market for thermal coal from the Black Thunder Mine has primarily been domestic coal-fired power plants, with minimal tonnage exported to Asia Pacific and South American customers.

The PRB can be segregated into three distinct tiers that affect the market reach and pricing for PRB coal. Mines operating in the southern area of the PRB (including the Black Thunder Mine) produce a higher quality coal (+ 8,800 Btu/lb) and are serviced by both the BNSF and the UP railroads. Coal from this area of the PRB has the farthest market reach, commands higher prices, and is generally in the highest demand.

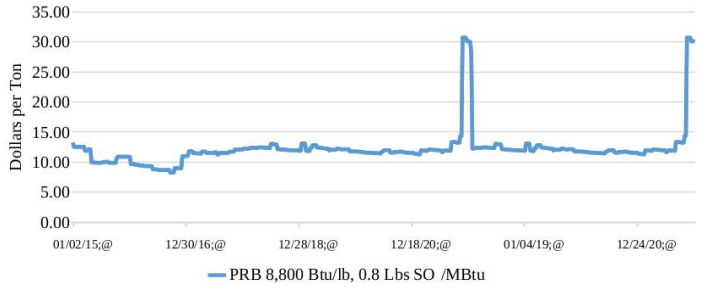
Mines operating in the central area of the PRB produce a lesser quality coal (8,400 Btu/lb) and are also serviced by the BNSF and the UP railroads. Coal from this area of the PRB moves mainly to Midwest utilities and generally has a price disadvantage relative to the higher quality coal from the southern PRB mines. With less market reach, the demand for coal from the mid-tier mines is the most volatile. In times of reduced thermal coal demand and depressed pricing, these mines are typically the first to realize tonnage reductions.

Mines in the northern area of the PRB typically have the lowest quality (8,200 Btu/lb) and are transportation disadvantaged due to service only by the BNSF railroad. Most of the current customers for the Northern PRB mines are located in the upper Midwest, mainly along the Great Lakes, due to limited rail transportation options out of the northern area of the PRB.

Thermal coal sales prices are influenced by many factors, including domestic supply and demand, global supply and demand dynamics, productivity, cost of competing fuels, transportation, and inflation, both mining cost inflation and general inflation.

The average historical spot pricing of PRB coal (8,800 Btu/lb, 0.8 lbs SO_2/MBtu) is shown on Figure 16.1-1 as follows:

Figure 16.1-1 Historical PRB Spot Price



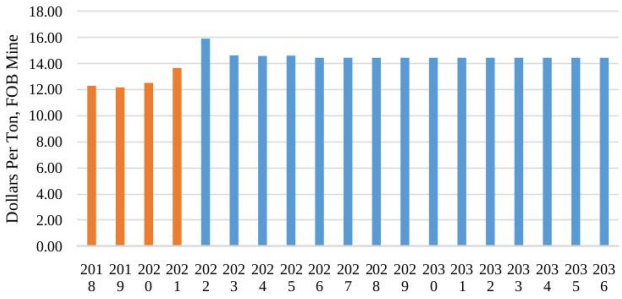
Source: S&P Global Market Intelligence

PRB coal spot pricing realized significant increases in 2021 due largely to high natural gas prices increasing power plant demand for coal as a more economic fuel source. The increase in demand and finite coal supply, resulted in average annual coal prices increasing from $11.67 per ton in 2020 to $15.03 per ton in 2021, representing a 29 percent increase year-over-year. While only a small portion of PRB coal is actually sold on the spot market, anticipated spot market pricing is a key input in most contract price negotiations.

In 2021, approximately 811,000 tons (1.3 percent) of Black Thunder Mine production was exported, with the majority being exported to Asia Pacific customers and the balance to South American customers. Arch anticipates increasing exports in 2022 to approximately 2.1 million tons.

The Black Thunder Mine annual average coal sales price realizations (which reflect quality adjustments) from 2018 through October 2021 ranged from $12.17 to $13.66 per ton. Arch provided projected FOB Mine coal sales prices for the Black Thunder Mine from 2022 through 2036, which WEIR utilized in the Black Thunder Mine LOM Plan financial model. The Black Thunder Mine historical (2018 through October 2021) and projected (2022-2036) FOB Mine coal sales price are shown on Figure 16.1-3.

Figure 16.1-3 Historical and Projected Coal Sales Price



The Black Thunder Mine LOM Plan FOB Mine coal sales price projected by Arch averages $14.66 per ton between 2022 and 2036.

16.2 MATERIAL CONTRACTS

The Black Thunder Mine saleable thermal coal product is marketed by the Thunder Basin Coal Company, with the exception of coal exported through Westshore Terminals in Vancouver, Canada, which is marketed by Arch Coal Asia-Pac., both subsidiaries of Arch.

Arch holds rail contracts for its export shipments, with the BNSF for coal movement through Westshore Terminals in Vancouver, Canada, and with the UP for coal movement through Houston Bulk Terminal. These contracts are renewed as needed to support export sales tonnage.

17.0 ENVIRONMENTAL STUDIES, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS AGREEMENTS

17.1 ENVIRONMENTAL STUDIES

As part of the permitting process required by the Wyoming DEQ, numerous baseline studies and impact assessments were undertaken by Arch. These baseline studies and impact assessments included in the permit are summarized as follows, with pertinent text from the permit replicated below:

- Groundwater
- Surface Water Quality and Quantity
- Probable Hydrologic Consequences

Groundwater

The Black Thunder permit area is located on the east limb of the Powder River Structural Basin in northeastern Wyoming. The east limb of the basin dips two to three degrees to the west. The primary formations which crop out in the vicinity of the Black Thunder Mine are the Wasatch Formation and the Fort Union Formation. Both formations are characterized by interbedded sandstone, siltstone, claystone, shale, carbonaceous shale and coal. The Wyodak-Anderson coal marks the top of the Fort Union Formation and is the primary seam to be mined. Clinker or scoria adjacent to either the coal or the Wasatch Formation is common throughout the area.

Locally, the Wyodak-Anderson coal seam, the Wasatch Formation, the Quaternary sediments, and the scoria deposits all contain water, however much of the Wasatch Formation is incapable of yielding water at a sufficient rate to serve as a practical water supply. The Wasatch Formation is too impermeable to yield the quantities of water necessary to justify the cost of well construction. Even the more permeable sandstones within the Wasatch are often not extensive enough to supply a continuous, reliable yield of more than a few gallons per minute (gpm).

The structure of the basin and local topography are the main factors controlling ground-water movement within the Powder River Basin. On a regional basis, flow moves from peripheral recharge areas (Scoria outcrops) toward the center of the basin. Locally, shallow ground-water movement is affected by topography. Infiltrating water falling on topographically high areas generally moves downward and laterally in the overburden. Depending on the local geology, this results in water in the overburden system recharging the coal or discharging to nearby

valleys. The water reaching the coal through the overburden system also generally moves downward and laterally to discharge areas in nearby valleys.

There are four significant native hydrogeologic units at the Black Thunder Mine: the overburden, which includes the Wasatch Formation and Quaternary sediments; the Wyodak-Anderson coal, the top of which marks the top of the Fort Union Formation; the underburden, which is comprised of that part of the Fort Union Formation that is below the coal; and the clinker which occurs at the same stratigraphic level as both the coal and the overburden. The saturated scoria deposits and the Wyodak-Anderson coal are considered the only aquifers within the permit area. There are few sandstone units in the Wasatch overburden within the permit area, and the Quaternary sediments are too thin and fine-grained to be significant aquifers.

Surface Water Quality and Quantity

The Black Thunder Mine is located in the Cheyenne River drainage basin. The main streams on and near the permit area are Little Thunder Creek, North Prong of Little Thunder Creek, or simply North Prong and HA Creek. Little Thunder Creek and North Prong join just east of the permit area. Little Thunder Creek then flows into Black Thunder Creek several miles downstream of the permit area as does HA Creek, which joins Black Thunder Creek about five miles east of the permit area. Black Thunder Creek is tributary to the South Fork of the Cheyenne River.

The Black Thunder Mine is located in the middle of the Little Thunder Creek drainage basin. Little Thunder Creek and North Prong flow from west to east, and the majority of the runoff from areas within the Black Thunder Mine permit boundary will flow into one of these two streams with the remaining runoff flowing into Black Thunder Creek via HA Creek and an additional minor tributary.

The geomorphology of the general area is typical of the eastern Powder River Basin with its gently rolling terrain. The topography within the Little Thunder Creek drainage basin is gently rolling in the western areas but becomes more rugged in the eastern portion near the Rochelle Hills. The eastern and southern portions of the permit area display some of the characteristics of this rugged terrain in steep-sided, irregular gullies and washes which drain into Little Thunder Creek. These features form breaks in a plateau and contrast with more gently rolling terrain to the north and east. North of the Little Thunder Creek valley, the topography is dominated by a broad, gently rolling plain which extends westward and northwestward beyond the permit area. Within this plain, in Section 17 of T43N, R70W, is an internally drained area

which contains an intermittent lake, or playa, at its low point. Further northeast, this plain drops off into the valley of the North Prong of Little Thunder Creek. The valley of the North Prong is generally broad and gentle with a steep southeastern rim. In the western part of the permit area, the valley of Little Thunder Creek is incised into a large, level plain which contains other undrained depressions, each containing one or more playas.

The Little Thunder Creek drainage system cuts into the Tertiary Wasatch and Fort Union formations, but stream valleys are primarily underlain by the Wasatch Formation. Structural and bedrock controls on stream channel orientation are reflected in the sub-dendritic drainage pattern. Streams are often oriented parallel to the northwest-to-southeast structural trends, and abrupt changes in channel direction may follow major joint or fault trends.

Elevations in the Little Thunder Creek drainage basin range from approximately 5,160 feet above mean seal level (MSL) in the headwaters area to approximately 4,100 feet above MSL at the confluence with Black Thunder Creek. Drainage basin characteristics for major streams intersecting the permit area (Little Thunder Creek, North Prong, Mills Draw, Shipley Draw, Holmes Creek, West School Creek, Burning Coal Draw Trussler Creek, and HA Creek) are found in Permit No. 233. All streams in the permit area are ephemeral, flowing only in response to precipitation or snowmelt events.

A small area in the northeastern portion of the permit area is within the drainage of HA Creek, which joins Black Thunder Creek approximately five miles east of the permit area. Another small portion of the permit area drains northward into a tributary to Black Thunder Creek.

The general area surrounding the Black Thunder Mine is characterized by ephemeral streams. The drainage basins convert little precipitation to runoff because of generally dry soil conditions, high evapotranspiration rates, high initial abstractions, non-contributing areas, stock ponds, and reservoirs. These factors, in addition to low-frequency, low-magnitude precipitation events result in low average annual volume of runoff.

Streamflow data for the general area have been obtained from the USGS publications. Hydrographs generated for the Little Thunder Creek gaging station near Hampshire, Wyoming and the Black Thunder Creek gaging station near Hampshire, Wyoming.

The hydrographs show a definite seasonal trend with regard to streamflow. Little Thunder Creek and Black Thunder Creek are more likely to exhibit streamflow events between March 1 and September 30 than at other times of the year. Flows occurring outside of this period tend

to be of very low magnitude, less than 5 cubic feet per second (cfs). Black Thunder Creek flow records show two exceptions to the general seasonal trend in 1974 when relatively large flow events occurred in January (63 cfs) and November (55 cfs) of 1974. These events probably also occurred on Little Thunder Creek at a lower magnitude, however, no record exists for comparison.

The hydrographs also show long periods of no flow between each streamflow event. Almost without exception, the hydrographs return to zero shortly after each flow event. This is indicative of the lack of baseflow. Therefore, although there is a seasonal trend to the occurrence of streamflow, the flow is by no means continuous during this period.

The duration of individual streamflow events is also illustrated on the hydrographs and provides further support that the streams in the general area flow only in response to precipitation events. Streamflow on Little Thunder Creek generally occurs for a period of less than 7 days with the exception of the March and May 1978 events. The duration of these flow events was less than 14 days each. Sixty percent of the time, Little Thunder Creek has had an average streamflow of less than 0.1 cfs and 86 percent of the time an average daily streamflow of less than 0.8 cfs.

The streamflow characteristics discussed in this section provide support for classifying the streams in the general area as ephemeral. The information provided shows that the streams exhibit no base flow, flow only in response to precipitation events, and each streamflow event is separated by extended periods of no flow.

Probable Hydrologic Consequences

Field investigations of the reach of North Prong from the east permit boundary to the confluence with Little Thunder Creek were performed to supplement an assessment of the probable hydrologic consequences of the Little Thunder Creek Diversion. Black Thunder prepared channel descriptions and cross sections for 63 locations along North Prong. Culverts and dams in the study area were identified on maps and inspected to determine how they would affect flood flows and channel erosional conditions.

Samples of channel bed and bank material were taken at eleven of the cross section locations. Laboratory analyses of selected samples were performed for density, particle size and Atterburg limits.

Inspection of the small dams in Section 22 and 23, T.43N., R.70W. showed evidence of rill erosion, sparse vegetation and compaction by livestock. Well defined spillways were not evident. Instead, overflows occurred at low points adjacent to the dams. At all points where overflows re-enter the channel, head cutting was occurring at the point of re-entry. Several inactive or washed out structures were identified where the stream had either cut a new channel around the dam or the dam had failed and a new channel had been cut through the structure.

Detailed channel cross sections of North Prong were constructed from field surveys. Valley cross sections are presented in the same figures along with the detailed channel cross sections to show the spatial relationship between colluvium and alluvium in the North Prong channel.

A channel profile for North Prong was prepared using existing maps and aerial photography. A longitudinal profile for Burning Coal Draw reflects upward concavity typical of most natural channels. Slopes are nearly flat near the drainage divide and change to a maximum slope of 1.7 percent before flattening out again.

17.2 REFUSE DISPOSAL AND WATER MANAGEMENT

Refuse Disposal

The Black Thunder Mine produces a saleable ROM coal product that only needs crushing to meet customer size and quality requirements, and therefore there is no need for coal processing and associated refuse disposal.

Water Management

Water used for dust suppression at the Black Thunder Mine is obtained from the highwall dewatering program to maintain highwall stability. Approximate use of the water from the dewatering wells is 500,000 to 800,000 gallons per year.

Surface and groundwater outlets are sampled in accordance with the approved Wyoming NPDES permit. Surface water sampling is limited because the occurrence of streamflow in Little Thunder Creek, North Prong and their tributaries is erratic.

Arch has a work practice that outlines the procedures for properly obtaining field measurements (e.g., pH, flow, etc.) and collecting representative water samples at the Black Thunder Mine permitted property. The procedures described in the work practice pertain to water sampling at the outfalls/outlets and stream monitoring locations. The sampling

frequency, outlets/outfalls, stream monitoring locations, and associated parameters are summarized in the Black Thunder Mine permits, as well as Arch's Water Discharge Permit Compliance Environmental Operating Procedure (EOP). This work practice improves overall compliance by providing a comprehensive summary of applicable water quality monitoring requirements in the permit, the Wyoming NPDES rules for coal mining facilities at Title 47, Series 30 (47CSR30), and the EPA regulations under 40 CFR Part 136.

The laboratories have internal quality control and quality assurance protocols that are followed before delivering sample results to the Arch Permitting Department. The permitting department reviews the sample results once again, as a second check for quality control and quality assurance before the results are published.

17.3 PERMITS AND BONDING

Coal mines in Wyoming are required to file applications for and receive approval of mining permits issued by the State of Wyoming, Department of Environmental Quality, Land Quality Division to conduct surface disturbance and mining activities. The Black Thunder Mine has been issued mining permits and associated NPDES permits by the Wyoming DEQ as shown in Table 17.3-1 as follows:

Table 17.3-1 Black Thunder Mining and NPDES Permits

Permit Number	Permitted Surface Area (Acres)	Issue Date	NPDES Permit No.
233	62,066.12	12/3/1974	WY0024091

Permit 233 includes the areas for the surface mine, material handling facilities and associated support facilities and infrastructure. The associated NPDES permit is required to allow discharges of water from the permit areas and requires submittal of bi-monthly water samples to ensure the discharges are within allowable water quality standards.

The entirety of the Black Thunder Mine LOM Plan area is permitted. Of the 62,066 permitted acres, Black Thunder has reclaimed 15,307 acres in various phases of bond release, with 1,258 acres soiled and seeded, 934 acres with Phase I release, 11,994 acres with Phase II release and 1,21 acres with Phase III release, as of April 2021.

The permitted area, bond amounts and reclamation liability for Permit 233 is shown in Table 17.3-2 as follows:

Table 17.3-2 Black Thunder Mine Permitted Area, Reclamation Liability, and Bonds

Permit Number	Permitted Surface Area (Acres)	Reclamation Liability [1] ($000)	Bond Amount ($000)
233	62,066	223,000	419,100

[1] Represents the undiscounted cash flows to satisfy reclamation as of December 2021

17.4 LOCAL STAKEHOLDERS

As indicated in Section 13.5, Arch currently employs approximately 1,024 personnel at the Black Thunder Mine and is projected to have a maximum employment of 1,078 personnel in 2022 and decreasing in subsequent years over the Black Thunder Mine LOM Plan. The mine also creates substantial economic value with its third-party service and supply providers, utilities and through payment of taxes and fees to governmental agencies.

The Black Thunder Mine is located in a rural and fairly isolated area of Wyoming. Reportedly, there have been no social or community impact issues relative to the Black Thunder Mine for several years.

17.5 MINE CLOSURE PLANS

Reclamation of the mined surface areas will follow coal extraction, in accordance with plans included in the current Wyoming DEQ Permit No. 233. The land will be graded to blend with existing topographic features. Drainage systems will be reestablished. Some internally drained areas (playas) will be created to replace those existing in the pre-mine landscape. Contoured surfaces will be dressed with topsoil and planted to a variety of grasses, forbs, and shrubs.

The Black Thunder Mine's permit number, permitted surface area, end of mine reclamation liability estimated by Arch, and bond amount, is shown in Table 17.3-2. The bond amount of $419.1 million is the mine closure and reclamation cost estimate for the projected December 31, 2021 mine disturbance, per the Wyoming DEQ bonding guidelines.

17.6 ENVIRONMENTAL COMPLIANCE, PERMITTING, AND LOCAL INDIVIDUALS OR GROUPS ISSUES

Permit No. 233 has not been cited for any permit violations since 2014, which is exceptional.

Black Thunder takes pride in its environmental stewardship and has had numerous environmental achievements over the years. The list of environmental achievements is shown in Table 17.6-1.

Table 17.6-1 Environmental Achievements

Achievement	Year (s)
WY Reclamation Award	2018, 2016, 2014
Arch Coal President's Environmental Award	2018, 2017, 2016, 2014, 2012, 2011, 2010
Conservation Legacy Award	2012
Interstate Mining Compact Commission - Public Outreach	2010
Excellence in Surface Mining - Good Neighbor Award	2008, 2006
Peck Community Service Award	2006
Wyoming Game and Fish Department's Industry Reclamation and Wildlife Stewardship Award	2005
United States Forest Service Prairie Partner Award	2002
Excellence in Mining Awards	2008, 2006, 1998-1997, 1993-1991, and 1989-1987

Based on WEIR's review of Arch's plans for environmental compliance, permit compliance and conditions, and dealings with local individuals and groups, Arch's efforts are adequate and reasonable in order to obtain approvals necessary relative to the execution of the Black Thunder Mine LOM Plan.

17.7 LOCAL PROCUREMENT AND HIRING COMMITTMENTS

While not a commitment, the Black Thunder Mine trains and hires applicants from the local communities.

18.0 CAPITAL AND OPERATING COSTS

Arch provided historical operating costs and capital expenditures for the Black Thunder Mine, which were an adequate check and basis for the Black Thunder Mine LOM Plan cost projections. The operating costs and capital expenditures are included in the financial statements that are audited annually by Ernst & Young LLP for Arch's SEC 10-K reporting. The auditing performed by Ernst & Young, LLP is conducted in accordance with the standards of the Public Company Accounting Oversight Board.

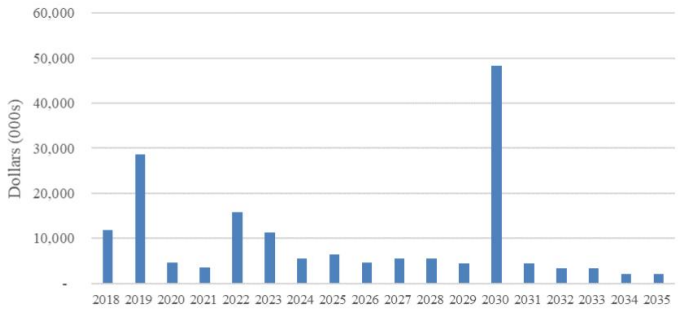
18.1 CAPITAL EXPENDITURES

The Black Thunder Mine will require capital to be expended each year for infrastructure additions/extensions, as well as for mining equipment rebuilds/replacements to continue to produce coal at currently projected annual levels of production.

Arch investments in the Black Thunder Mine, since inception, are considered "Sunk Costs" and as economic returns in this economic analysis are presented only on a forward-looking basis, Sunk Costs are not included in the economic return of the project, as estimated in this study.

Actual capital expenditures for 2018 through October 2021 and projected capital expenditures for November 2021 through 2035, in 2021 dollars, are shown on Figure 18.1-2.

Figure 18.1-2 Historical and Projected LOM Plan Capital Expenditures



Note: 2018 through October 2021 YTD are actual, LOM Plan includes 10 percent contingency

The majority of the capital expenditures shown on Figure 18.1-2 are for maintenance of equipment. The large increase in capital expenditures in 2030 is related to the one-time relocation of a road and railroad to allow mining the coal beneath these surface features.

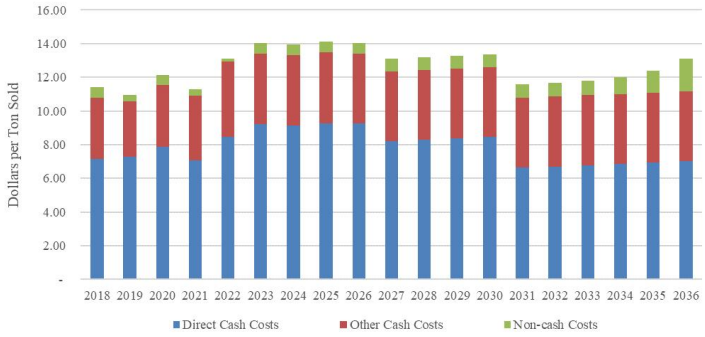
Black Thunder Mine management has had several years of experience estimating capital expenditures for surface mining and the risk of inaccurate estimates is low. The Black Thunder Mine LOM Plan projected average capital expenditures of $0.19 per ton (including contingency) which is identical to the three-year historical average of $0.19 per ton. Capital expenditure projections per annual ton are estimated to have an accuracy of +/- 25.0 percent.

Contingency costs account for undeveloped scope and insufficient data. Contingency for required major projects and mining equipment is estimated at 10 percent and is intended to cover unallocated costs from lack of detailing in scope items. It is a compilation of aggregate risk from estimated cost areas.

18.2 OPERATING COSTS AND RISKS

Operating costs are projected based on historical operating costs and adjusted based on projected changes in staffing, hours worked, production, and productivity for mining areas in the LOM Plan. The Black Thunder Mine actual and LOM Plan projected operating costs in dollars and dollars per ton, are shown on Figure 18.2-1.

Figure 18.2-1 Black Thunder Mine Historical and LOM Plan Operating Costs



Note: 2018 through 2020 are actual, 2021 actual through October

Descriptions or explanations of the operating costs considered in the Black Thunder Mine LOM Plan are as follows:

- Labor cost, which includes wages and benefits for hourly and salary personnel at the mine and material handling systems.
- Contract mining cost, which includes payments for third party companies providing services for mining activities.
- Maintenance and supplies costs, which are expenses related to upkeep of mining equipment and associated infrastructure.
- Tires and tubes costs, which are expenses primarily related to rubber tired mobile equipment.
- Operating supplies costs, which are various items used for mine operations and the material handling infrastructure.
- Explosives costs, which are expenses related to blasting overburden rock material.
- Utilities costs, which are expenses related primarily to the purchase of power to operate electrical equipment in the mine and material handling systems, telephone and data lines, water, and garbage services.
- Fuels and lubes costs, which are expenses related to diesel fuel, gasoline, motor oil and grease.
- Equipment leases and rent costs, which are expenses related to equipment leased or rented for office and mining activities.
- Taxes and insurance costs, which are expenses related to sales taxes on purchased goods and services and to property and liability insurance for risk management purposes.
- Miscellaneous/contract services costs, which include items such as security services and fines and penalties.

The Black Thunder Mine LOM Plan projected cost of sales of $13.15 per ton is $1.76 per ton higher than the four-year historical average of $11.39 per ton for the Black Thunder Mine. With the long history of cost of sales, no contingency is included, although the accuracy of the LOM Plan projected cost of sales should be considered to be within 15 percent of the historical average.

Capital and Operating Cost Estimation Risk

The Black Thunder Mine has been in operation since 1977 and has had a relatively long period relative to experience with capital and operating costs. Since the mining operation will

continue in the same coal seam and planned mining conducted in the same manner as historical mining, there is little risk associated with the specific engineering estimation methods used to arrive at projected capital and operating costs. An assessment of accuracy of estimation methods is reflected in the sensitivity analysis in Section 19.3.

For purposes of the Preliminary Feasibility Study completed relative to the Black Thunder Mine LOM Plan, capital costs are estimated to an accuracy of +/- 15 percent, with a contingency of 10 percent and operating costs are estimated to an accuracy of +/- 15 percent, with no contingency.

19.0 ECONOMIC ANALYSIS

19.1 ASSUMPTIONS, PARAMETERS, AND METHODS

A Preliminary Feasibility Study financial model has been prepared in order to assess the economic viability of the Black Thunder Mine LOM Plan. Specifically, plans were evaluated using discounted cash flow analysis, which consists of annual revenue projections for the Black Thunder Mine LOM Plan. Cash outflows such as capital, including sustaining capital costs, operating costs, transportation costs, and taxes are subtracted from the inflows to produce the annual cash flow projections. Cash flows are recognized to occur at the end of each period. There is no adjustment for inflation in the financial model, and all cash flows are in 2021 dollars. WEIR's study is conducted on an un-levered basis, excluding costs associated with any debt servicing requirements.

To reflect the time value of money, annual net cash flow projections are discounted back to the project valuation date, using a discount rate of 10 percent. The discount rate appropriate to a specific project depends on many factors, including the type of commodity and the level of project risks, such as market risk, technical risk, and political risk. The discounted present value of the cash flows are summed to arrive at the project's NPV.

Projected cash flows do not include allowance of any potential salvage value. Additionally, capital previously expended (sunk cost) is not included in the assessment of economic returns.

Arch has indicated that based on accrued Net Operating Losses (NOLs), Arch does not anticipate necessary income tax payments relative to the Black Thunder Mine. Royalties are forecasted based on mineral lease rates and anticipated mine plan progression through various lease boundaries within the Black Thunder Mine resource area.

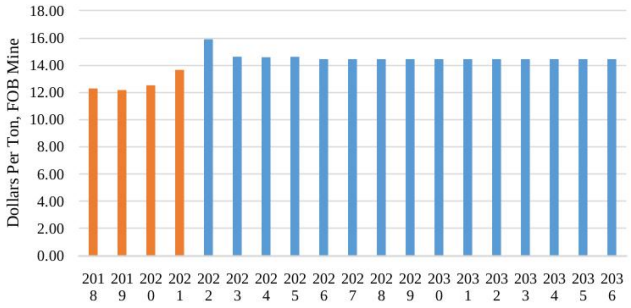
In addition to NPV, the Internal Rate of Return (IRR) is also calculated. The IRR is defined as the discount rate that results in an NPV equal to zero. Payback Period is calculated as the time required to achieve positive cumulative cash flow for the project at a 10 percent discount rate. As the Black Thunder Mine is ongoing with no initial investment required (i.e. already sunk cost), payback period is less than one year.

The Preliminary Feasibility Study financial model developed for use in this TRS is meant to evaluate the prospects of economic extraction of coal within the Black Thunder Mine resource

area. This economic evaluation is not meant to represent a project valuation. Furthermore, optimization of the LOM Plan was outside of the scope of this engagement.

The actual and Black Thunder Mine LOM Plan coal sales price forecasts used to estimate revenue are shown on Figure 19.1-1.

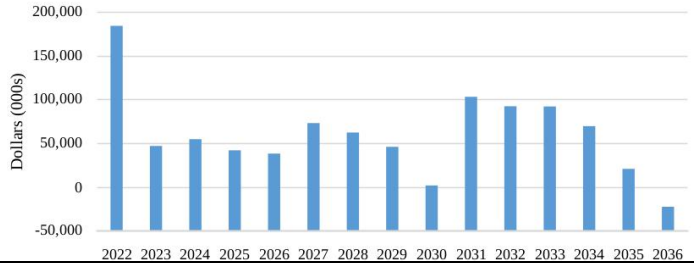
Figure 19.1-1 Historical and Projected Coal Sales Price



19.2 ECONOMIC ANALYSIS AND ANNUAL CASH FLOW FORECAST

Annual cash flow for the Black Thunder Mine LOM Plan is shown on Figure 19.2-1 as follows:

Table 19.2-1 Annual Cash Flow Forecast



The Black Thunder Mine LOM Plan has an after-tax NPV of $512.0 million, at the base case discount rate of 10 percent (Table 19.2-2). As the Black Thunder Mine is ongoing with no initial investment required (i.e. already sunk cost), the IRR indicates that the project NPV is infinite. Cumulative (undiscounted) cash flow over the LOM Plan is positive, at $730.5 million. The calculated Return on Investment (ROI) is 617 percent.

The after-tax NPV, IRR, cumulative cash flow and ROI are summarized in Table 19.2-2 as follows:

Table 19.2-2 After-Tax NPV, IRR, Cumulative Cash Flow, and ROI

	LOM Plan
NPV ($000)	511,954
IRR (%)	Infinite
Cumulative Cash Flow ($000)	730,521
Return on Investment (%)	617

Table 19.2-3 presents key operational statistics for the LOM Plan on an after-tax basis. Over the LOM Plan, the average operating cost is $13.15 per clean ton sold. Operating costs include direct cash costs, other cash costs, and non-cash costs.

Table 19.2-3 Key Operating Statistics

	LOM Plan
Yards Moved (000s)	2,027,647
Clean Tons Produced (000s)	545,000
Stripping Ratio (CY/Ton)	3.75
Marketable Tons Sold (000s)	545,000
	($ Per Ton)
Coal Sales Realization	14.67
Direct Cash Costs	8.26
Other Cash Costs	4.20
Non-cash Costs	0.69
Total Cost of Sales	13.15
Profit / (Loss)	1.51
EBITDA	2.20
CAPEX	0.19

19.3 SENSITIVITY ANALYSIS

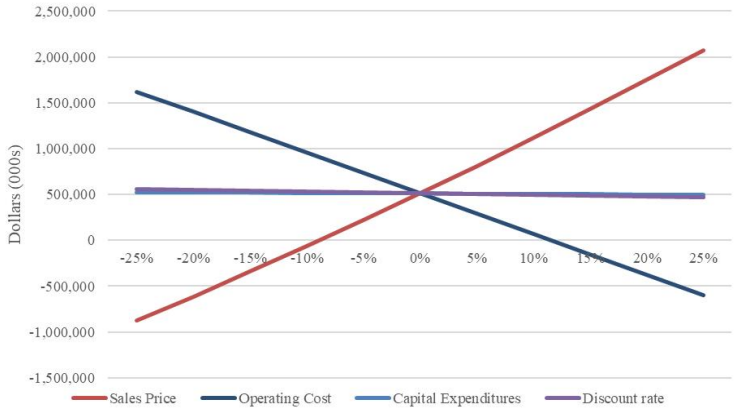
A sensitivity analysis was undertaken to examine the influence of changes to assumptions for coal sales price, operating cost, capital expenditures, and discount rate on the base case after-

tax NPV. The sensitivity analysis range (+/- 25 percent) was designed to capture the bounds of reasonable variability for each element analyzed. The basis for reasonable variability for each element analyzed is summarized as follows:

- Coal Sales Price - Historical coal sales price variability of 12 percent between 2018 and 2021
- Operating Cost - Estimated accuracy of +/- 15 percent
- Capital Costs - Assumed accuracy of +/- 15 percent
- Discount Rate - based on range of variability from 7.5 to 12.5 percent

Figure 19.3-1 depicts the results of the NPV sensitivity analysis.

Figure 19.3-1 Net Present Value Sensitivity Analysis



The chart above shows that the project NPV is most sensitive to changes in coal sales price and operating cost. It is least sensitive to changes in the discount rate and capital expenditures.

20.0 ADJACENT PROPERTIES

This TRS does not include any estimates of coal resources or coal reserves associated with adjacent (adverse) properties.

Adjacent properties to the Black Thunder Mine are shown on Figure 1.1-1.

Geological data outside of the Black Thunder Mine Property was provided to WEIR for inclusion in the report analysis. This data has been used in the geological structure and quality model but is not shown in the data trends related to figures in this report. Utilizing the data outside of the Black Thunder Mine Property ensures that the model is able to trend with known data though the boundary where reserves and resources are estimated. This in turn provides a more realistic estimation on tonnages and quality along the borders of the Black Thunder Mine Property.

21.0 OTHER RELEVANT DATA AND INFORMATION

Conducting a due diligence investigation relative to the mineral and surface rights of Arch's mining operations was not part of WEIR's scope of work. This TRS is based on Arch controlling, by lease or ownership, or having the ability to acquire the coal reserves and surface lands necessary to support its mine plans.

The ability of Arch, or any coal company, to achieve production and financial projections is dependent on numerous factors. These factors primarily include site-specific geological conditions, the capabilities of management and mine personnel, level of success in acquiring reserves and surface properties, coal sales prices and market conditions, environmental issues, securing permits and bonds, and developing and operating mines in a safe and efficient manner. Unforeseen changes in legislation and new industry developments could substantially alter the performance of any mining company.

Coal mining is carried out in an environment where not all events are predictable. While an effective management team can identify known risks and take measures to manage and/or mitigate these risks, there is still the possibility of unexpected and unpredictable events occurring. It is not possible therefore to totally remove all risks or state with certainty that an event that may have a material impact on the operation of a coal mine will not occur.

22.0 INTERPRETATIONS AND CONCLUSIONS

22.1 SUMMARY OF INTERPRETATIONS AND CONCLUSIONS

Interpretation

Arch has a long operating history of resource exploration, mine development, and mining operations at the Black Thunder Mine, with extensive exploration data including drillholes, and seam elevation measurements supporting the determination of mineral resource and reserve estimates, and projected economic viability. The data has been reviewed and analyzed by WEIR and determined to be adequate in quantity and reliability to support the coal resource and coal reserve estimates in this TRS.

Conclusion

The coal resource and coal reserve estimates and supporting Preliminary Feasibility Study were prepared in accordance with SEC S-K 1300 requirements. There are 205 million in-place tons of measured and indicated coal resources, exclusive of reserves, and 545 million clean recoverable tons of surface mineable reserves within the Black Thunder Mine LOM Plan, as of December 31, 2021. Reasonable prospects for economic extraction were established through the development of a Preliminary Feasibility Study relative to the Black Thunder Mine LOM Plan, considering historical mining performance, historical and projected metallurgical coal sales prices, historical and projected mine operating costs, and recognizing reasonable and sufficient capital expenditures.

22.2 SIGNIFICANT RISKS AND UNCERTAINTIES

Risk, as defined for this study, is a hazard, condition, or event related to geology and reserves, mine operations and planning, environmental issues, health and safety, and general business issues that when taken individually, or in combination, have an adverse impact on Arch's development of the Black Thunder Mine. Risks can disrupt operations, adversely affect production and productivity, and result in increased operating cost and/or increased capital expenditures.

In the context of this TRS, the likelihood of a risk is a subjective measure of the probability of the risk occurring, recognizing the magnitude of the risk defined as follows:

> *Low Risk* indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, should not have any material adverse effect on the economic viability of the project.

Moderate Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a detrimental effect on the economic viability of the project.

High Risk indicates that the combined probabilities (low/medium/high) together with the economic impact (minimal/significant/adverse), if conditions exist, could have a seriously adverse effect the economic viability of the project.

Based on a review of available information and discussions with Arch personnel, WEIR identified potential risks associated with the Black Thunder Mine LOM Plan. The risks, WEIR's assessment of risk magnitude, and comments based on WEIR's experience with surface mining operations are summarized in Table 22.2-1 as follows:

Table 22.2-1 Black Thunder Mine Risk Assessment Summary

Area of Risk	WEIR Risk Assessment	Comments
Coal Quality	Low	Black Thunder has a long history of meeting customer requirements.
Geology and Coal Reserves	Low	The Wyodak Seam has been extensively mined by the Black Thunder Mine. This mining has not indicated any anomalies in the seam other than normal thinning and thickening, and encountering expected minimal water originating from overlying sandstone strata.
Land Acquisition	Low	No additional land or mineral is necessary to attain or sustain the LOM Plan.
Gas Wells	Low	There are 10 gas wells that will have to be acquired and plugged prior to mining. Black Thunder Mine has successfully acquired, plugged, and mined through gas wells historically.
Highwall Stability	Low to Moderate	The potential for a highwall failure when mining is monitored as a part of the normal mining operation. The highwall angle has been designed based on geotechnical studies to achieve a factor of safety greater than 1.30.
Qualified Employees	Low	The Black Thunder Mine employment is at the maximum level for the LOM Plan. Employment levels will decline throughout the LOM Plan and skilled workers will be retained.
Rail Lines	Low	Historically, the volume of coal transported out of the PRB was much greater than current volumes. The rail line capacity is more than adequate to transport the tonnage in Black Thunder's LOM Plan.
Spontaneous Combustion	Low	Black Thunder does not store coal in open stockpiles and the potential for heating of the coal from spontaneous combustion is low. On shift inspections by management personnel would likely identify any heating events.
Water Inflow	Low to Moderate	There have been areas where the Black Thunder Mine has encountered water inflow from the water-bearing sandstone overburden. Dewatering wells continually address any water encountered to mitigate issues leading to highwall failures.

It is WEIR's opinion that the majority of the risks can be kept low and/or mitigated with proper engineering, planning and monitoring of the mining operations.

23.0 RECOMMENDATIONS

The Black Thunder Mine have sufficient geologic exploration data to determine mineral reserves. Future exploration work will be undertaken by Arch to continuously provide geological data primarily for use by mine operations personnel related to effective implementation of the LOM Plan. Future exploration work should include what has been historically implemented related to the following:

Geology

- Have an experienced geologist log core holes, measure core recovery, complete sampling. Geophysically log core holes to verify seam and coal thickness and core recovery.
- Geophysically log rotary holes to verify strata and coal thickness.
- Continue to prepare laboratory analysis of any core hole samples.

Mine Plan

- Continue to monitor the dewatering wells results relative to minimizing groundwater and the impact on highwall stability.

24.0 REFERENCES

References used in preparation of this TRS are as follows:

- BARR Engineering Co. 2021. *Geotechnical Highwall Stability Assessment for the Black Thunder Mine Operation*
- Thunder Basin Coal Company, LLC. 2009 (updated 2018). *Ground Control Plan*
- Arch, 2012, Resource Recovery and Protection Plan
- WYDEP Permit No.233

Websites Referenced:

- Securities and Exchange Commission - Modernization of Property Disclosures for Mining Registrants - Final Rule Adoption
  https://www.sec.gov/rules/final/2018/33-10570.pdf
- MSHA Data Retrieval Site
  https://www.msha.gov/mine-data-retrieval-system

25.0 RELIANCE ON INFORMATION PROVIDED BY THE REGISTRANT

In preparing this report, WEIR relied upon data, written reports and statements provided by the registrant. It is WEIR's belief that the underlying assumptions and facts supporting information provided by the registrant are factual and accurate, and WEIR has no reason to believe that any material facts have been withheld or misstated. WEIR has taken all appropriate steps, in its professional opinion, to ensure information provided by the registrant is reasonable and reliable for use in this report.

The registrant's technical and financial personnel provided information as summarized in Table 25.1 as follows:

Table 25.1 Information Relied Upon from Registrant

Category	Information	Report Section
Legal	Mineral control and surface rights	3
Geotechnical	Highwall Stability, and rock quality analyses	13.1.1
Hydrogeological	Hydrogeological Analysis including inflow rates, permeability and tranmisivity calculations, and watershed analysis	13.1.2
Marketing	Coal sales price projections	16
Environmental	Permits, bond, and reclamation liability	17
Macroeconomic	Real price growth (coal sales, labor and other cash costs)	18