11 Mineral Resource Estimate (Item 11)

Development drilling is used with the Geovia Minex. Gridded drilling results are used to the parameters for this algorithm are customized for each individual trend, using the appropriate economic and geotechnical parameters.

11.1 Assumptions, Parameters, and Methods

Drillholes are on approximately 100 foot spacing. For each area, Geovia Minex software is used to construct a model of seam layers, including three ore zones, an upper, middle and lower, as well as other waste layers. The ore zones are based on a 0.3% BeO cut-off grade and the software creates structure grid surfaces for the seam roof (SR) and seam floor (SF) of each layer on a 10-by-10-foot grid size. The surfaces created are then clipped to a polygon bounding the drill data. Table 11-1 shows the parameters for drill spacing as it relates to reserve classification for each area.

Table 11-1: Borehole Spacing (ft) for Reserve Classifications

Production (tons)	Classification	Fluro	Blue Chalk	Camp	Monitor	Rainbow	Sigma	Southwind
240,000	Measured	150	126	50	63	165	77	108
300,000		168	138	68	67	192	85	119
360,000		186	149	72	71	218	90	126
240,000	Indicated	> 600	252	207	210	> 600	181	218
300,000		> 600	276	246	249	> 600	199	254
360,000		> 600	286	267	270	> 600	222	274

11.1.1 Blue Chalk

The boundary for Blue Chalk's reserve was created at 285-foot spacing from the drillholes, shown in Figure 11-1: Blue Chalk Area Drillholes and Reserve Boundary. The structure gridding algorithm was performed on a 20-foot mesh size for layers. Ore zones were then gridded using a 10-foot mesh size for the thickness and grade modeling. Modeling was then validated by reviewing cross sections with the drillhole data base on 500-foot intervals. An example is shown in Figure 11-2: Blue Chalk Modeled Cross Section The seam surfaces were then trimmed to the reserve boundary and by the current pit mining toe survey.

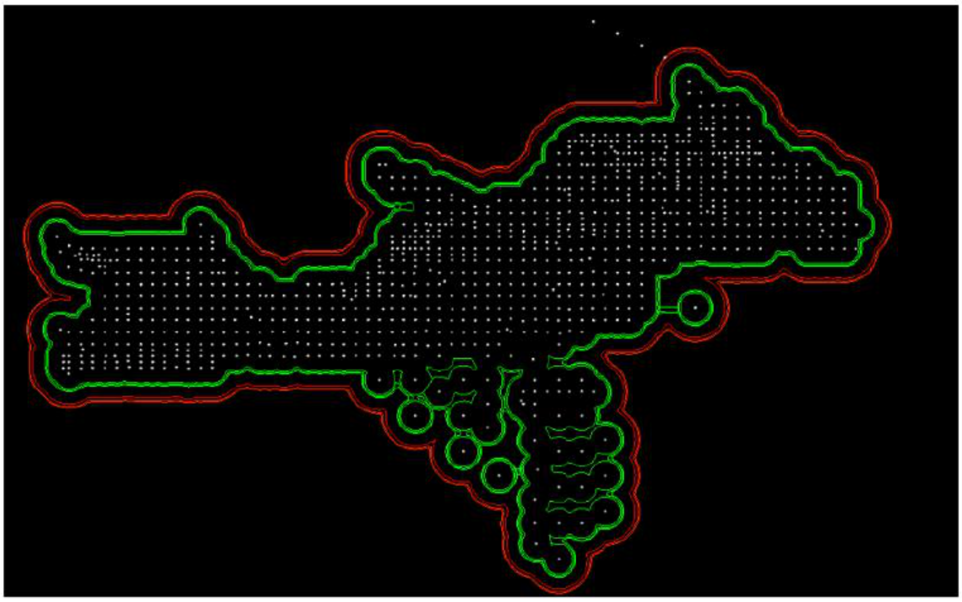


Figure 11-1: Blue Chalk Area Drillholes and Reserve Boundary

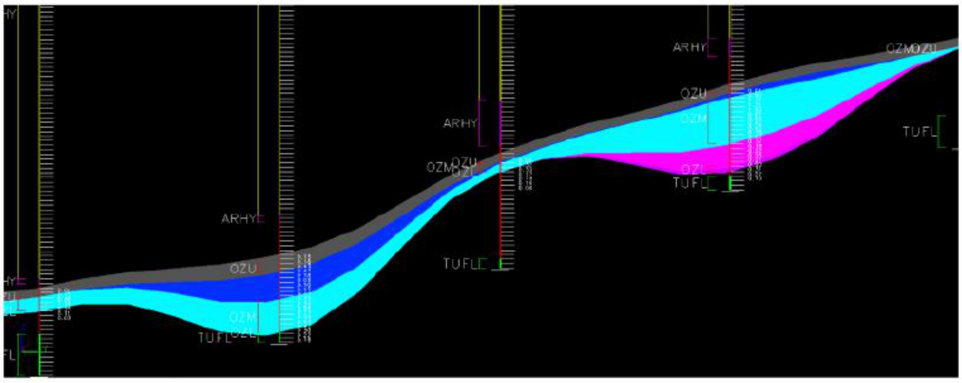
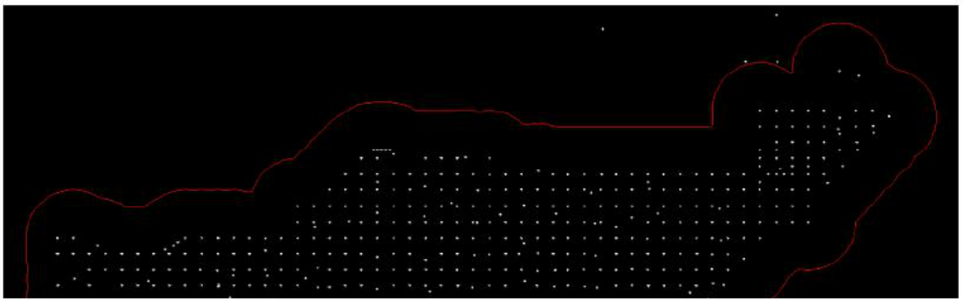


Figure 11-2: Blue Chalk Modeled Cross Section

11.1.2 Fluro

The boundary for Fluro's reserve was created at 300 foot spacing from the drillholes, shown in Figure 11-3: Fluro Area Drillholes and Reserve Boundary. The standard cut-off of 0.3% BeO was used, however a detailed section review revealed one outlaying hole with a 0.26% BeO interval that was excluded at this cut-off and limiting the modelling to that edge. To extend the layer modeling to this boundary hole, it was included as part of the OZM. The structure gridding algorithm was performed on a 20-foot mesh size for layers. Ore zones were then gridded using a 10-foot mesh size for the thickness and grade modeling. Modeling was then validated by

reviewing cross sections with the drillhole data base on 500-foot intervals. The seam surfaces were then trimmed to the reserve boundary and to a previously mined and backfill area boundary.



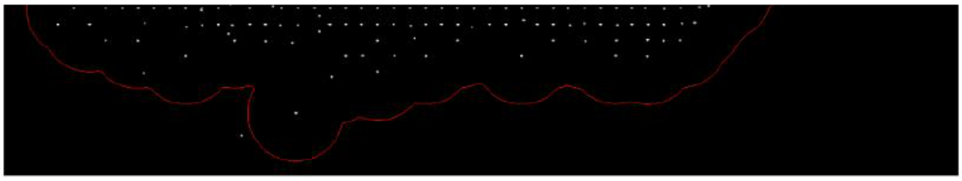


Figure 11-3: Fluro Area Drillholes and Reserve Boundary

11.1.3 Monitor

The boundary for Monitor's reserve was created at 270 foot spacing from the drillholes. The 0.3% BeO cut-off was used with a minimum of 0.5ft of thickness to be used in the building the layers. However, several small gaps within the larger boundary were kept in though they did not meet these minimums for the sake of modeling continuity, they are currently considered to be subgrade material. These key holes are shown in yellow along with the outer reserve boundary in Figure 11-4. The structure gridding algorithm was performed on a 25-foot mesh size for layers. Ore zones were then gridded using a 10-foot mesh size for the thickness and grade modeling. Modeling was then validated by reviewing cross sections with the drillhole data base on 500-foot intervals. The seam surfaces were then trimmed to the reserve boundary and by the pit mining toe survey.

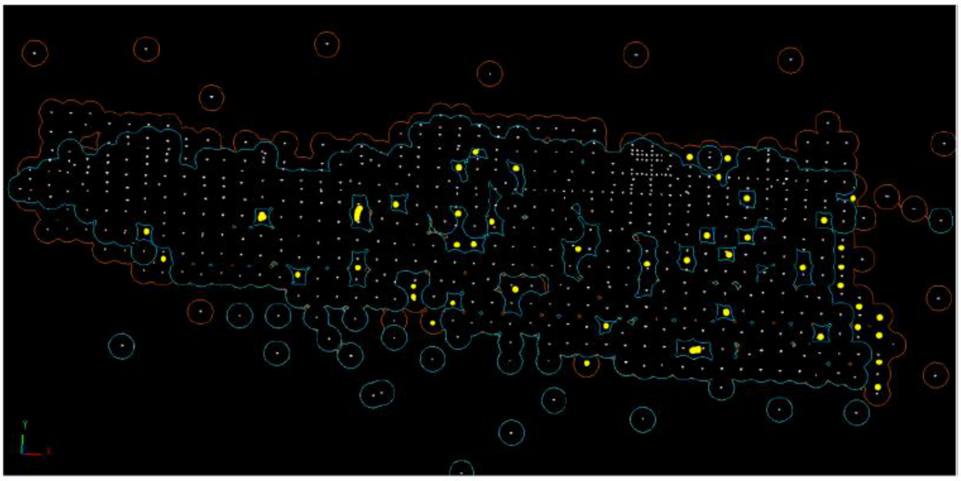


Figure 11-4: Monitor Area Drillholes and Reserve Boundary

11.1.4 Rainbow

The boundary for Rainbow's reserve was created at 350-foot spacing from the drillholes. This was based on the Spacing Report done by Minex. Additionally, the Rainbow area is bounded by two major fault trends on each side. An older boundary was used in order to reflect the effects of these faults. In Figure 11-5 the faults are shown in lime green, the 350-foot boundary in light blue, and the conservative boundary used to account for the faulting in dark blue. The structure gridding algorithm was performed on a 25-foot mesh size for layers. Ore zones were then gridded using a 10-foot mesh size for the thickness and grade modeling. Modeling was then validated by reviewing cross sections with the drillhole data base on 500-foot intervals. The seam surfaces were then trimmed to the old reserve boundary, which also limits out previously mined areas.

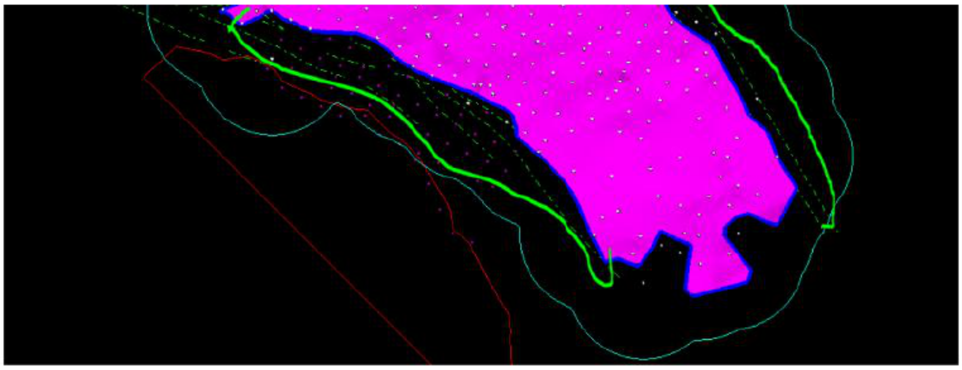


Figure 11-5: Rainbow Area Drillholes and Reserve Boundary

11.1.5 South Wind

The boundary for South Winds's reserve was created at 275-foot spacing from the drillholes. The 0.3% BeO cut-off was used with a minimum of 0.5ft of thickness to be used in the building the layers. However, similar to Monitor, several small gaps within the larger boundary were kept in though they did not meet these minimums for the sake of modeling continuity and are considered to be subgrade material. A previously mapped fault zone in the southeastern tail of the area has also caused issues with the ore zone reaching the surface, thus, a previous boundary was used in this area to trim that fault zone out of the modeling. Figure 11-6 shows the outer reserve boundary along with the fault zone cutting boundary in yellow and the ore zone surface built based on cut-offs to be trimmed in light blue. The structure gridding algorithm was performed on a 25-foot mesh size for layers. Ore zones were then gridded using a 10-foot mesh size for the thickness and grade modeling. Modeling was then validated by reviewing cross sections with the drillhole data base on 500-foot intervals. The seam surfaces were then trimmed to the reserve boundary and by the pit mining toe survey.

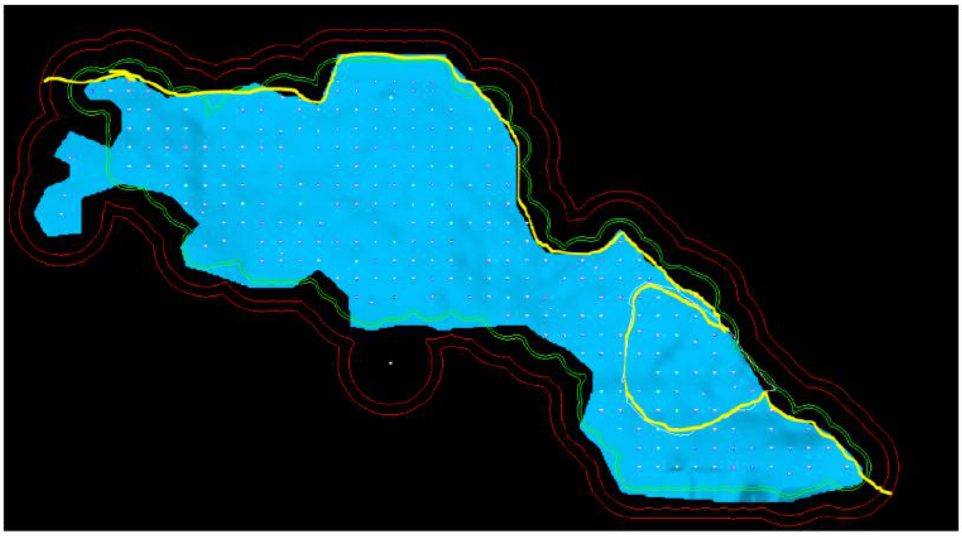


Figure 11-6:Southwind Area Drillholes and Reserve Boundary

11.2 Audit by Gustavson

The grid estimation / growth algorithm used by Minex is described in Geovia literature. The exact calculation is considered proprietary. Gustavson has used a standard industry software called Micro Model, to replicate the Mineral Resource estimate for the Rainbow deposit. Rainbow is the pit currently in production. The use of standard tools combined with the 3-D structural surfaces for Rainbow, resulted in a grade and tonnage estimate not materially different from the estimate produced by Minex.

Gustavson believes that the methods used by Materion are appropriate for mine design and planning purposes. Differences in the model and mill reconciliation are attributable to faulting within the pit areas at a scale difficult to identify with the development drill spacing. Gustavson recommends additional geological mapping in the mining areas before and during operation.

11.3 Mineral Resources

All ore within the reserve boundary and external to the optimized pit is considered as resource material. Ore within the designed pit limits is Mineral Reserve (details on this classification and reporting are found in Section 12-1). Resource reporting is exclusive of Reserves. Additionally, the Anaconda area is included as an Inferred Resource. The ore estimates for these areas was done externally to Materion and has not been confirmed. The Resources for the property are reported in Table 11-2.

Table 11-2: Spor Mountain Resources

Location	Indicated Mineral Resources		Inferred Mineral Resources	
	Tons (dry)	% BeO	Tons (dry)	% BeO
Blue Chalk North	826	0.568		
Blue Chalk South	17,079	0.285		
Section #16	72,909	0.358		
West Group	245,058	0.328		
Fluro	358,408	0.392		
South Roadside	-	0.000		
Rainbow	350,584	0.278		
Monitor	148,725	0.392		
South Wind	193,320	0.364		
Sigma Emma	31,018	0.440		
Camp	22,329	0.700		
T.B.C. East Group	64,160	0.375		
Robyn Anaconda			1,813,100	0.009
South Wind Anaconda			816,700	0.011
Total	1,504,416	0.354	2,629,800	0.010

11.4 Basis for Estimate

11.4.1 Cut-off grades

An internal cut-off grade of 0.2 to 0.3% BeO is used. This cut-off has historically been shown to be representative of successful operating margins for Materion.

11.4.2 Commodity Prices

Materion sets the price for its products on a cost-plus basis in private contracts with its clients. These prices can fluctuate with the relative cost of mining and processing as opposed to a set or market determined value. Gustavson has analyzed the historic trends and projected the 2022 price based on historical and contract factors. A detailed discussion of pricing and profitability is contained in Section 19.

11.5 Classification and Criteria

Materion classifies its Reserve and Resources categories based on the distance from drillholes. The criteria for each deposit are shown in Table 11-1. Several of the deposits have been drilled densely enough that the only non-reserve materials are at the fringes of the deposits.

11.6 Uncertainty

Drilling is curtailed at margins where the deposits become too deep to economically mine, though it is acknowledged that there is likely continuity of the ore seam to greater depths. Further drilling at these extents could potentially add some amount of resource material that would be economic at greater commodity prices. However, given the nature of the beryllium market, Materion's share of the effect on the overall commodity price, and the existing longevity of their Mineral Reserves, this would not necessarily add substantial benefit to their operation given the cost of the drilling, and may not meet the criteria for eventual economic extraction of a Mineral Resource.

12 Mineral Reserve Estimate (Item 12)

Gridded drilling results are used to create optimized pit boundaries using a modified Lerchs-Grossman algorithm. The parameters for this algorithm are customized for each individual trend, using the appropriate economic and geotechnical parameters. Materion uses these pit boundaries as well as the boundaries for Measured and Indicated to delineate Proven and Probable Mineral Reserves.

12.1 Assumptions, Parameters and Methods

Each pit is optimized using Geovia Minex software. Cost parameters are based off experience in the mining that has occurred with each area thus far and adjusted for inflation. Gustavson has reviewed the cost parameters used and finds them reasonable given the analysis done in Section 18. Waste density is based on the average from past stripping projects. Ore densities and grades are based averages of previous mining in each area. Slope Angles are based on experience and are currently under review.

Table 12-1: Optimization Physical Parameters by Area

Property	Average Grade BeO%	Highwall Slope Angle	OZM Density (SG)	OZW Density (SG)	WAST Density (SG)
BCS16	0.59	45	1.69	1.96	2.31
Fluro	0.75	45	1.71	1.96	2.31
Rainbow	0.83	42	1.53	1.96	2.31
Monitor*	0.76	45	1.47	1.96	2.31
SW*	0.71	45	1.55	1.96	2.31
Sigma	0.61	45	1.59	1.96	2.31
Camp	0.60	45	1.59	1.96	2.31
Family	0.41	45	1.59	1.96	2.31

Each area is then queried for ore materials within its respective pit and Measured and Indicated boundaries based on drillhole spacing. Ore in-pit and within the Measured boundary is considered Proven. Ore in-pit and within the Indicated boundary is considered Probable. Probable reserves are reported exclusive of Proven materials Several areas had the entirety of the in-pit ore within

Measured boundary, and thus had no Probable materials to report.

12.2 Mineral Reserves

Reserves are shown by area in Table 12-2.

Table 12-2: Spor Mountain Reserves

Location	Proven Mineral Reserves		Probable Mineral Reserves		Total Mineral Reserves	
	Tons (dry)	% BeO	Tons (dry)	% BeO	Tons (dry)	% BeO
Blue Chalk North	191,017	0.566	9,959	0.604	200,976	0.568
Blue Chalk South	528,030	0.603	17,578	0.686	545,608	0.606
Section #16	1,109,567	0.539	160,543	0.590	1,270,110	0.546
West Group	925,048	0.663	160,789	0.781	1,085,837	0.683
Fluro	1,955,709	0.747	50,631	0.825	2,006,340	0.749
South Roadside	14,668	0.587	-	-	14,668	0.587
Rainbow	694,262	0.830	-	-	694,262	0.830
Rainbow PH2 LMU 2 STKPL 5	60,137	0.923			60,137	0.923
Rainbow PH2 LMU 2 Zone 6	54,500	0.849			54,500	0.849
Monitor	776,199	0.736	268,979	0.844	1,045,178	0.767
South Wind	717,464	0.676	47,158	0.995	764,623	0.704
Sigma Emma	409,946	0.600	83,154	0.633	493,100	0.606
Camp	279,535	0.603	115,628	0.536	395,163	0.585
T.B.C. East Group	22,541	0.423	47,709	0.434	70,250	0.431
Total	7,738,623	0.680	962,127	0.717	8,700,751	0.684

12.3 Basis for Estimate

12.3.1 Cut-off grades

An internal cut-off grade of 0.3% BeO is used. This cut-off has historically been shown to be representative of successful operating margins for Materion. This is supported by sharp grade changes at the borders of the mineralized zone creating an abrupt grade boundary.

12.3.2 Commodity Prices

Materion sets the price for its products on a cost-plus basis in private contracts with its clients. These prices can fluctuate with the relative cost of mining and processing as opposed to a set or market determined value. Gustavson has analyzed the historic trends and projected the 2022 price based on historical and contract factors. A detailed discussion of pricing and profitability is contained in Section 19.

12.4 Classification and Criteria

Measured and Indicated Mineral Resources within the designed pit limits are classified as Proven and Probable Mineral Reserves, respectively, based on a variography study performed in 2015. Materion classifies its Reserve and Resources categories based on the distance from drillholes. The criteria for each deposit are shown in Table 10.1. Several of the deposits have been drilled densely enough that the only non-reserve materials are at the fringes of the deposits.

13 Mining Methods (Item 13)

Mining is open pit and areas are mined and scheduled in units determined through optimization software and anticipated needs for blending. Long term models have seven discrete pits that are ultimately to be mined. The mining is carried out with a modified benching scheme in which the benches follow the dip of the deposit and thus may increase in thickness as the mining advances.

Overburden blasting and removal are performed by a contractor. Any topsoil or suitable surficial material are removed and reserved for future reclamation. Rhyolite waste material is blasted and then moved with truck and shovel, while alluvium and tuff do not need to be blasted and can be removed with scrapers.

After the removal of the initial overburden, secondary drilling on 25-foot centers yields a detailed grade control model that is then used in the mining process. This vertical drilling extends down through the ore body and into the underlying footwall, waste material beneath it and is used for creating a detailed interpretation of the ore body to be used as a grade control model for subsequent mining. Materion performs the secondary stripping, which may be done with dozers, excavators or scrapers. Ore is mined by Materion crews using the same equipment and grade control continues to be monitored with a field Berylometer. All ore material is spread into stockpiles. Stockpiles are intentionally constructed with ore spread in thin, intermingling layers. These stockpiles are then further drilled, surveyed and sampled before being loaded into belly-dump, over the road trucks to be transported to the mill. Waste material is placed in nearby waste dumps or used to backfill mined out pits.

13.1 Geotechnical, Hydrogeological, and Relevant Parameters

Monitor and Southwind have 25% built into cost for pumping, based on experience. Pit slope requirements are further discussed in Section 7.4.

13.2 Production Rates, Mine Life, Unit Dimensions and Dilution

Ore is mined in Logical Mining Units (LMUs) and ore is generally not blended. Within LMUs ore is typically reasonably homogenous and can be characterized such that the mill can adjust its processing parameters to optimize the recovery based on the ore's chemical analysis.

At present the mine is operating about 160 days per year and the Plant is operating at 50% capacity. The production rate is set to meet the manufacturing and sales needs of the parent company. Beryllium materials sales contracts with both the government and private industrial customers are used to forecast the 12-18 month outlook, and this outlook is then extrapolated into a longer term plan. The mine and plant are capable of significant scale up, however the need for such scale up is not foreseen at this time. Production is maintained at a steady rate based on market conditions.

13.3 Development Requirements

The mine is presently in production. Development of future pits is scheduled into the production plan. An LMU or multiple LMUs are stripped of primary overburden in one large campaign by contract mining crews. This typically takes place in the years preceding the scheduled mining of that LMU, making areas available for mining well ahead of when they are needed.

An evaluation of constant "just in time" stripping simultaneous with production mining is under review. The capital committed to maintain an entire pit stripped in advance of mining is a significant factor in the overall operating costs.

13.4 Mining Fleet and Requirements

13.4.1 Materion Current Mobile Fleet

- 657G Scraper
- 631E Scraper
- D9R Dozer
- D8L Dozer
- 580K Backhoe (Case)
- 330BI Excavator
- 950G Loader*

- 906 Loader*
- 140G Road Grader
- AM 4000-gallon water truck
- GMC Fuel and Lube truck w/ 650-gallon diesel capacity

*Equipment located at the processing plant.

13.4.2 Pre-Stripping Contractor Current Fleet

- D9R Dozer
- 365 Excavator
- 385 Excavator
- 390 Excavator
- 4x 773 Rock Truck
- 6x 775 rock Truck
- D8 Dozer
- 14G Grader
- Water truck
- Tractor/beegee
- Fuel/lube truck
- Mechanic truck

This allows the company to maintain the mining rate with the current 160 operating days per year in the mine. Punctual needs for increased production can be addressed with a small number of extra shifts.

13.5 Map of Final Mine Outline

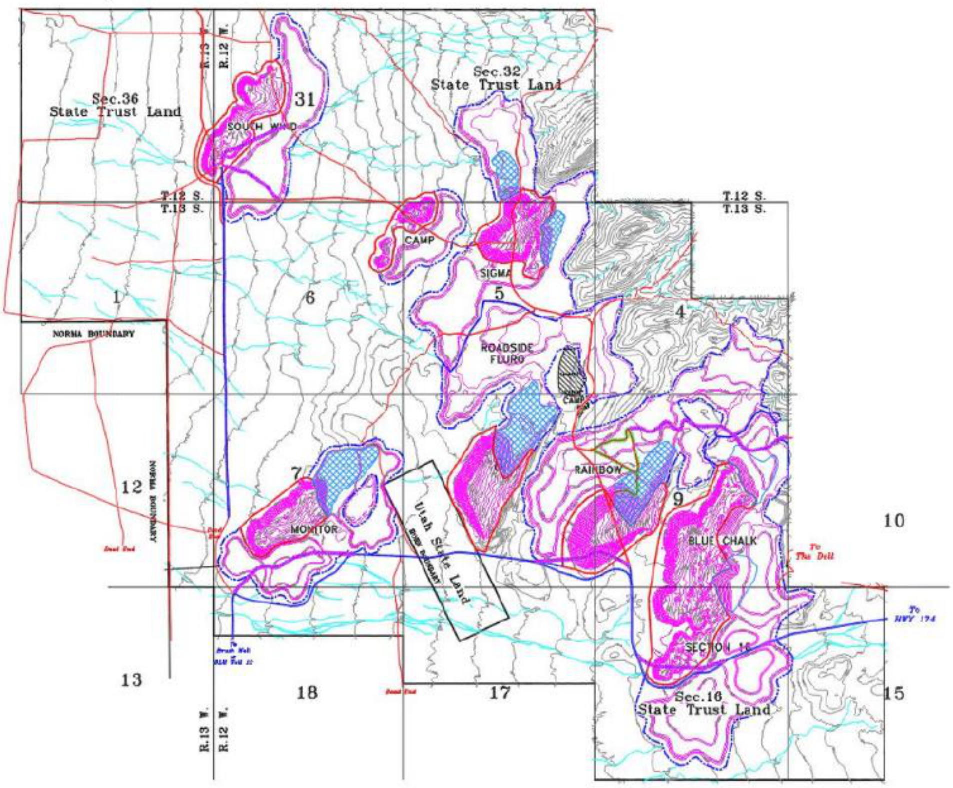


Figure 13-1: Final Mine Outline

The second phase of Rainbow is currently in production. Mined out phases include the first phases of Fluro, Monitor, and Rainbow, and the second phase of South Wind, while Mineral Reserves remain in phases three through five of South Wind, phases two through eight of Blue Chalk South Section 17, phases three and four of Rainbow, phases two through five of Fluro, phases three through five of Monitor, and the third phases of Sigma, Camp, and Family.

14 Recovery Methods (Item 14)

14.1 Description or Flowsheet of Plant

The processing plant accommodates a feed of Bertrandite ore to result in a Beryllium Hydroxide concentrate. Spor Mountain Run of Mine ore is of the Bertrandite variety.

Previously Beryl ore was processed from certain deposits. The Beryl process is more expensive and challenging to operate. The quantities of Beryl ore have declined until that portion of the plant has been decommissioned.

The block process flow is shown in Figure 14-1, showing the process categories which will be described in detail.

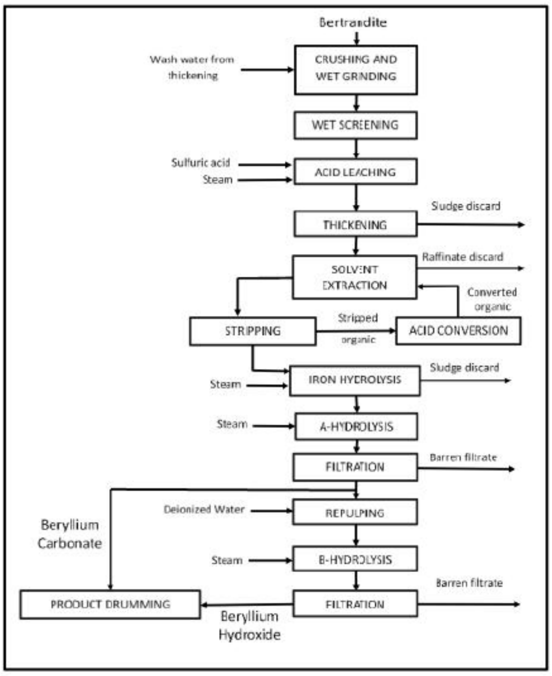


Figure 14-1: Block Process Flow Diagram

The mineral processing consists of several steps.

14.1.1 Crushing & Grinding

Ore is hauled from the mine's stockpiles 50 miles to the mill via a semi and belly dump trailers. The trailer dumps the run of mine ore into four different ore bins. Material size ranges from 18 inches to fines less than -200 mesh. The material is then fed through a crusher, ball mill and several screens until the ore size is approximately -20 mesh in a 40wt% solids slurry.

14.1.2 Leach

Slurry is diluted to approximately 24% solids in the leaching process. The leaching process consists of two parallel atmospheric leach trains. Steam and sulfuric acid are added at multiple steps through each leach train. The leaching process releases beryllium along with other impurities from the ore into the water phase.

14.1.3 Counter- Current Decantation (CCD)

Leached slurry is diluted down to a 10-12% solids to enter the CCD process. The CCD area consists of eight thickener tanks that separate out the aqueous beryllium from the unleached solids (tailings). The tailings are sent out to the tailings storage facility, the beryllium containing liquor is sent to solvent extraction.

14.1.4 Solvent Extraction

The extraction train consists of a series of mixers and settlers. The aqueous beryllium stream is fed at one end of the extraction train while the unloaded organic is fed at the other end of the extraction train. The counter-current contact process captures most of the beryllium.

The solvent extraction mixers agitate the oil and water, making small oil & water bubbles which allow the aqueous beryllium to be captured by the extractant in the organic. From the mixer the water and organic move into a settler where the lighter weight organic floats and the water sinks. At the end of the settler oil and water move in opposite directions to the next mixing stage.

After extraction the beryllium carrying organic is sent to the strip section of the plant where the low pH organic stream is contacted with a high pH ammonium carbonate. The beryllium ends up as an ammonium beryllium carbonate and is carried in the product water stream to hydrolysis. Sulfuric acid is added to the organic to reduce pH to the extraction conditions and the organic returns to the extraction train.

The water streams from the extraction, strip and acid conversion sections are sent to the water collections system and ultimately for evaporation at the tailings storage facility.

14.1.5 Hydrolysis & Filtration

After solvent extraction there are several more steps to purify the beryllium and make beryllium hydroxide. The removal of iron by hydrolysis is completed by holding the ammonium beryllium carbonate at temperature for a short time, then filtering the residual iron solids.

Next, the ammonium beryllium carbonate is decomposed in a hydrolyzer just below atmospheric boiling temperature. The ammonia and carbon dioxide freed during hydrolysis are captured and recycled back to the strip area of solvent extraction. The product beryllium carbonate is filtered and sent to a third hydrolyzer where the carbonate is stripped at a higher temperature and pressure. Final filtration removes most of the water and the product beryllium hydroxide is drummed for shipment to customers.

14.2 Plant Design and Equipment Characteristics

The mineral process plant was designed by Stearns-Roger Corp in 1967, and first went into production in 1969. The plant design was optimized by JBR Consultants Group in 1986, and upgraded in 1987 with the goal of improving tailings handling and reducing process water use through dry stack tailings.

14.3 Energy, Water, Material, and Personnel Requirements

Electricity requirements are met via the power grid, and water is from company owned wells. Just over 100 operating personnel are currently employed at the operation, with slight fluctuations.

14.4 Justification for Non-Standard Processing Methods

The Spor Mountain operation is currently the only raw ore beryllium processing facility in the western hemisphere. The process was engineered by Stearns-Roger Corp. in 1967 and was upgraded in 1987 for improved performance. The plant has had approximately 50 years to be tuned to the bertrandite bearing ore mined from the known pits.

The process is a combination of processing methods utilized in other commodities that are carefully tuned for bertrandite beryllium ores. As such the Spor Mountain plant defines standard bertrandite processing today.

15 Project Infrastructure (Item 15)

15.1 Roads

The site is accessible by vehicle on Utah State Highway 174. There are several county roads that traverse the property and provide access. Materion has several pit access roads that have been dozed, graded and maintained. All routes are marked with signage prohibiting public access without Materion permission and escort.

15.2 Rail

Rail runs adjacent to the mill and is used for delivery of sulfuric acid and raffinate used in processing. It is not used for conveyance of ores or concentrates.

15.3 Dumps

Dumps have been designed to infill existing channels in the alluvial fans and are recontoured and rounded to mimic a more natural topography. Some waste material is also used to filled mined-out pits and a similar regrading of the dump-tops is done.

15.4 Tailings Disposal

An evaporation pond is north of the mill. An additional pond is being permitted for future needs.

15.5 Power

There are no utility transmission lines near the mine. Generators are used to supply power. The power to the mill and administration building is supplied by lines adjacent to Route 6.

15.6 Water

The site has a water supply well, water supply pipeline and dust-control-water storage pond. The well is located on adjacent state land, managed by the School and Institutional Trust Lands Administration (SITLA), and Materion maintains a lease agreement for that area and its use. The pipeline that brings the water to site runs across BLM land at surface level. Potable water is trucked to the site for storage in cisterns.

16 Market Studies and Contracts (Item 16)

16.1 Markets

Spor Mountain is the only producer of Beryllium in the United States and one of a very limited number worldwide. According to a USGS report on the commodity, Materion has made greater than 60% of the world's beryllium production on 2019 and 2020. Approximately 170 tons of beryllium were consumed in 2020 for a value of about $110 million, thus a unit cost of around $320 per pound of beryllium. Beryllium is listed on the Shanghai Metals Exchange at an average of 5500 RMB per kilogram for the month prior to July 22, 2021. This equates to approximately $390 per pound (https://www.metal.com/ Other-Minor-Metals/201102250108). Materion is a lower cost producer compared to some overseas processing and recycling operations, and it can be assumed that the market will continue to bear the price that it sets given the limited number of alternative producers.

16.2 Contracts and Status

At present the terms of Materion's contracts with its customers are confidential. Sales contracts were reviewed by Gustavson staff, and we find that they compare favorably with advertised pricing for recycled beryllium.

17 Environmental Studies, Permitting and Social or Community Impact (Item 17)

17.1 Environmental Study Results

The air quality description below is taken in its entirety from EA No. J-01-099-042-EA (JBR, 1999a):

This area has been designated as in attainment for all pollutants. The air quality in the project area is generally very good and is classified as a Prevention of Significant Deterioration (PSD) Class II Area. A Class II designation allows for a moderate level of increase in ambient levels of criteria pollutants (specifically PM10, Nox, and SO2). The nearest Class I area, the most restrictive, is Capitol Reef National Park, approximately 140 miles southeast of the mining properties.

Existing sources of air emissions in the project area include primarily fugitive dust (particulate matter) and diesel and gasoline combustion associated with current mining activities (for vehicles and generators).

17.2 Operating and Post Closure Requirements and Plans

Currently the mine operates under the Bevill exemption from RCRA for the Land Disposal and Waste Rock Piles. Under this exemption, Materion is not obligated to regrade the pits or rock dumps. The extent of the reclamation of these areas will be to spread growth medium and seeding for the reestablishment of naturally occurring vegetation.

At present the mine is grandfathered in and does not require air permitting apart from abiding the Utah Air Quality Mining Rules. However, given the push from the Department of Air Quality (DAQ) to bring all sources under permit, there is a transition taking place with the technical assistance of Trinity and legal assistance of Holland and Hart to determine if a Notification of Intent and Permit is required.

Agreement with Juab County that roads in mining areas can be moved or temporarily closed during mining that affects them, and at mine closure will be re-established or permanently closed and reclaimed.

Because water more readily collects temporarily after rainfall events in the pits and behind waste rock dumps that impound some natural drainages, populations of some wildlife species have been enhanced (MRP pg. ES-3) The rhyolite and alluvium that make up the vast majority of waste rock are neither acid generating nor sources of otherwise leachable metals or salts. The tuff component of waste rock is isolated either as pit backfill or within rhyolite cover in waste rock dumps. As a result, impacts to ground water from mining operations are believed to be insignificant. The potential effects upon ground water from the Company's mining operations have been demonstrated to be minimus under the Utah Ground Water Quality Protections Rules and the mining operation has been determined by the Utah Division of Water Quality (UDWQ) to be permitted by rule (MRP pg. ES-4).

17.3 Required Permits and Status

Materion maintains the following permits. All are current as of the date of this report.

- SWPPP and SPCC for the Mine
- UPDES General Multi-Sector Permit for Stormwater Discharge permit through Utah Division of Water Quality (UDWQ)
- Discharge Permit (for Mill to discharge process solid and liquid waste to Tailings Storage Facility, including the new expansion area for tailings)
- Class IIIb Landfill Permit (for beryllium contaminated non-hazardous industrial waste to be disposed on site)
- NESHAP (for hazardous air pollutants, i.e., Beryllium)

- Title V Operating permit (for the mill), renewed in 2020
- Annual Utah Emissions Inventory Reporting under R307-150-1(3)
- DWMRC letter (solid waste management)
- Waste treatability studies under UAC R325-261-4(f)
- Reporting under 40 CFR 265 (classified as very small quantity generator, audited on 5-year basis by the state)

Ammonia is the only chemical over the EPA RMP threshold and a PSM program is currently under major renovation. Propane, sulfuric acid, ammonium sulfide, sodium hydroxide, and liquefied CO2 are under CAA general duty. Their programs will be upgraded in accordance with Ammonia improvement programs.

17.3.1 Post-Performance or Reclamations Bonds

The MRP details the extent, nature, and cost of reclamation for the mine. It is described as such:

> "The reclamation cost estimate in the 1988 MRP revision followed a tentative future mining plan, which was scheduled for completion in the year 2037. Reclamation bonding was done on a "steady-state" basis for a bonding period that peaked after fifteen years. The steady state bond amount was formulated by first determining the dates of projected liability incurrence and release and then by calculating the cumulative reclamation liability over the entire anticipated period of mining and reclamation. The cumulative reclamation liability calculation enabled the determination of the maximum reclamation liability for the reclamation bond period. This amount then became the steady state bond amount for that period of bonding. The bond amount in the reclamation contract included a contingency for supervision and the calculated escalation for the fifteen-year period (ending 2003). The reclamation contract established the "Escalation Year" to be 2005; the current contract, dated February 2012, moved it forward to 2016" (MRP pg.3).

Table 17-1: Bonding Calculations

Bonding Calculations	Existing & Phase 1*	Phase 2**	TOTAL	
Direct Costs				
Subtotal Demolition and Removal	$91,261.00		$91,261.00	
Subtotal Backfilling and Grading	$302,000.00	$1,249,400.00	$1,551,400.00	
Subtotal Revegetation	$69,300.00	$185,638.00	$254,938.00	
Subtotal Direct Costs	**$462,561.00**	**$1,435,038.00**	**$1,897,599.00**	
Indirect Costs				
Mob/Demob	$46,256.00	$143,504.00	$189,760.00	10.0%
Contingency	$23,128.00	$71,752.00	$94,880.00	5.0%
Engineering Redesign	$11,564.00	$35,876.00	$47,440.00	2.5%
Main Office Expense	$31,454.00	$97,583.00	$129,037.00	6.8%
Project Management Fee	$11,564.00	$35,876.00	$47,440.00	2.5%
Subtotal Indirect Costs	**$123,966.00**	**$384,591.00**	**$508,557.00**	26.8%
Total Cost 2013	**$586,527.00**	**$1,819,629.00**	**$2,406,156.00**	
Number of years				5
Escalation factor				0.015
Escalation	$45,329.00	$140,628.00	$185,957.00	
Reclamation Cost Escalated	$631,856.00	$1,960,257.00	$2,592,113.00	
Bond Amount (rounded to nearest $1,000) 2018 Dollars	**$632,000.00**	**$1,960,000.00**	**$2,592,000.00**	
Posted Bond			$1,398,000.00	
Difference Between Cost Estimate and Bond			$1,194,000.00	

*Detailed Cost workbooks for **Existing and Phase 1** calculations can be found in the following pages.
Detailed Cost workbooks for **Phase 2 calculations can be found in **Appendix 7**.

Source: (MRP Appendix 6)

17.4 Social and Community

The Spor Mountain Mine and mill has been part of the Delta, Utah, community for over 50 years. They are one of the larger employers in town, forming part of Delta's civic fabric.

17.5 Mine Closure

Materion stockpiles topsoil material and has been doing so since 1989. However, the natural topography is such that not much of this topsoil exists to be collected. Materion has carried out studies to determine the best material for revegetation as much of the site material is frequently saline and thus unsuitable. Tuff was initially proposed and tested as a good material, but a study of test plots concluded that was not the case. Studies have continued to determine the best available materials and soil amendments for future use as topsoil. At present, rhyolite materials are favored for revegetation. Planned amendments are inorganic mulch, organic mulch, mono-ammonium phosphate and gypsum. Three to six inches is to be placed over dump tops, ore stockpiles and the area of the camp and related facilities. If there is an adequate amount of the material, the dump outslopes will be covered as well. The mine uses an approved seed-mixture

of native vegetation for re-seeding. Much of the reclamation is done concurrent with mining. Phase 2 has integrated the reclamation efforts into the mining schedule.

Materion has succeeded in gaining approval from the Division of Oil, Gas, and Mining (DOGM) for a variance that excuse them from pit and dump slope regrading and backfill and topsoil replacement (MRP pg. 3).

Salvageable buildings, tanks, electrical generating equipment, communications systems and other stationary equipment, and mobile equipment will be sold for salvage or reuse. Concrete building foundations will be demolished and disposed in the onsite landfill, which is approved for disposal of demolition and construction debris. Portable buildings (e.g., office trailers) that cannot be salvaged will be demolished on site and disposed in the onsite landfill. Prior to removal from the site for salvage or re-use, the contents of all tanks will either be consumed or disposed properly. Electrical generating equipment, communications equipment (e.g., repeaters), other stationary equipment, and mobile equipment will be sold for reuse or for scrap (MRP pg. 54-55). The well is the property of SITLA and they will ultimately determine if it is to be plugged and abandoned at the end of mine life, or if they will continue its use.

Apart from the planned use of some pits as waste dumps, no other regrading is planned and the company has a variance in its permitting to allow this. Final levels of dumps are plug dumped and dozed to an undulating surface to blend with the surrounding areas more closely. Outslopes are graded to the angle of repose, making them stable enough to have qualified for a further variance from rule R647-4-111.6. The placement (when available of topsoil on these outslopes further soften their appearance to help them blend into the landscape. The landfill area is to be graded, covered with 5 feet of waste rock, 6 inches of topsoil, and revegetated.

The planned post-mining land use is wildlife habitat and livestock grazing. The Mine property may also attract recreational land users (e.g., rock hounding); however, the property will be posted and, when all mining and reclamation have been completed, may be fenced if necessary for safety purposes. Public recreation will not be a land use authorized by the Company (MRP pg.46).

17.6 Adequacy of Plans

It is Gustavson's opinion that Materion's current environmental compliance and permitting is within the state and federal laws and guidelines. The programs for maintenance and adherence to current regulatory guidelines and reporting are adequate.

17.7 Commitments to Local Procurement or Hiring

See Section 17.4.

18 Capital and Operating Costs (Item 18)

Because of the confidential nature of contracts for Materion's ore, operational costs are also considered sensitive in nature.

Capital and operating costs for both the mine and processing facilities were developed based on factored and quantity built up estimating techniques and benchmarking similar projects. These costs and equipment requirements were determined from a variety of sources including third-party mining cost databases, the authors' professional experience, and review of production and financial actuals from similar projects in the western United States.

The capital and operating costs detailed in this report have been reviewed by the qualified persons and are reasonable for inclusion in this report. A 20% contingency is applied to capital costs. A 10% contingency is applied to operating costs.

18.1 Capital and Operating Cost Estimates

18.1.1 Basis for Capital Cost Estimates

Capital that has been expended prior to the effective date is considered sunk and is not included. A two percent factor of the estimated sunk capital for fixed facilities and mine development was applied annually to account for sustaining capital, for $677,400 per year. Items included in these groupings include utilities, communications, roads, process plant, and shop/warehouse/office facilities. No salvage value is assigned to these capital costs.

The mobile fleet has been grouped into three sub parts, waste stripping (trucks, excavators, and support equipment), ore mining (scrapers, drills, dozers, and loaders), and ore hauling (highway trucks for conveyance to the process plant), that will have similar service lives and timelines for replacement. Each piece of the current fleet was assumed to be halfway through its useful life, and then incurs full replacement costs at the end of the service life interval. Through the life of the mine, each sub-fleet is replaced several times at the appropriate interval, 12 years for the Ore/Service fleet, 40 years for the ore mining fleet, and 8 years for the Ore Hauling fleet Purchases assume using lease to own financing, with financing terms assumes a 5-year term at a 6% interest rate. All mobile equipment costs assume an additional 10% cost for transportation. Mining equipment is exempt from state and local sales taxes. No salvage value is assigned to mobile equipment. No contingency costs are applied to the mobile equipment fleet. Table 18-1 contains an itemized table of the mining mobile equipment capital costs.

Table 18-1: Mining Mobile Equipment Capital

Equipment	Quantity	Unit Cost	Total Capital Cost
		($ Millions)	
Haul Truck - CAT 775	5	$1.07	$7.34
Excavator - CAT 390	2	$1.25	$3.44
Water Truck – CAT 775	1	$1.08	$1.48
Road Grader – CAT 14M	1	$0.47	$0.65
ANFO Loader	1	$0.26	$0.36
Fuel /Lube Truck Class 8	2	$0.14	$0.38
[illegible]	[illegible]	[illegible]	[illegible]

Light Trucks	5	$0.07	$0.28
Total of Waste & Service Fleet			$13.9
Drill Rig (15-25 cm diameter)	2	$1.33	$1.83
Dozer - D9	1	$2.82	$3.87
Scraper – CAT 657G	1	$1.97	$2.71
Loader – CAT 950G	1	$0.32	$0.44
Loader– CAT 906	1	$0.13	$0.17
Total of Ore Mining Fleet			$9.03
Truck Class 8 with Ore Trailer	3	$0.55	$2.29
Total of Ore Hauling Fleet			$2.29

The mine currently meets its environmental bonding requirement through a letter of credit with a bank on which they pay the interest, amounting to around $20,000 per year through the life-of-mine (LoM). In addition, they complete some concurrent reclamation. It is assumed that of the total estimated bonding amount given in the Mining and Reclamation Plan (MRP), $100,000 per year of concurrent reclamation will be done and the final balance of $1.0 million will be done at mine closure.

Capital costs were estimated over the entire life of the project of 123 years, the final year including reclamation. Sustaining capital for fixed facilities is estimated at $100.0 million, replacement cost for the mobile fleet at $173.3 million, reclamation and interest costs at $18.8 million, for a project total capital cost of $291.8 million.

Initial and Sustaining capital costs are detailed by area in Table 18-2. Sustaining capital includes credits for the salvage of equipment, return of environmental bonding, and working capital. Costs for each category shown include contingency.

Table 18-2: Project Capital Costs

Category	Cost ($ Millions)
Fixed Facilities Sustaining Cap	$100.0
Mobile Fleet Replacement	$173.3
Environmental & Other	$18.8
Total	$291.8

18.1.2 Basis for Operating Cost Estimates

Operating costs for the project are estimated over the life of the project using a first principles buildup from mine schedule quantities, unit costs, equipment operating hours, labor, and estimated consumables. Fixed costs (labor) and variable costs (equipment operation and consumables) are tabulated separately, which leads to variations in the unit operating costs per year due to a varying schedule. Operating costs for major cost centers are shown in Table 18-3.

Table 18-3: Project Operating Costs

Area	LoM Cost ($ Millions)	Average Unit Cost ($/tonne processed)
Mining	$994	$114.22
Processing	$2,448	$281.31
Site G&A	$165	$19.00
Contingency (10%)	$361	$41.45
Total	$3,967	$455.98

The basis of labor costs for all project areas is the number of employees and an annual, burdened wages based on the InfoMine mine cost data base. Staffing levels are based on the equipment fleet size or scaled from similar operations.

18.1.3 Mine Operating Costs

A breakdown of the mine operating costs over the LoM is shown in Table 18-4. Load and haul costs are costs associated with the loading of blasted material and transport to the ore stockpile or waste dump. The drill and blast area tracks costs associated with drilling blast holes and explosives consumed. Mine support contains costs associated with dozing at the waste dump and active face, dust suppression, grading of roads and utility work associated with mining. Mine maintenance includes maintenance labor for the mobile equipment fleet and operation of fuel/service trucks. Mine general and administrative (G&A) costs include salaried positions supporting mine operations.

Table 18-4: Mine Operating Costs

Area	LoM Cost ($ Millions)	Average Unit Cost ($/tonne processed)	Average Unit Cost ($/tonne mined)
Load and Haul	$534	$61.43	$1.01
Drill and Blast	$182	$20.96	$0.34
Mine Support	$107	$12.28	$0.20
Mine Maintenance	$46.9	$5.39	$0.09
Mine G&A	$123	$14.17	$0.23
Contingency (10%)	$93.8	$10.79	$0.18
Total	$1,032	$118.64	$1.95

The basis for the mine operating costs are as follows. For all cost areas, machine hours required to meet the mine schedule requirements are calculated and multiplied by an hourly unit cost. For loaders, excavators, scrapers, and haul trucks, the machine hours are calculated using an equipment productivity model and a haulage model, on an annual basis. The hourly unit costs are based on a database of equipment and includes fuel, maintenance parts, lubricants, tires, and ground engaging wear parts. Table 18-5 through Table 18-9 shows a detail of each mine operating cost area. Waste stripping operators are assumed to work in four rotating crew shifts. Operational hours to meet the ore mining schedule only requires one shift of scraper operation. Ore haulage to the plant requires two crews.

Table 18-5: Loading and Hauling OPEX

Area	LoM Cost - ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$177.2				
Waste Stripping Excavators	$45.8	701,789	Hours	$65.26	$/hr
Waste Stripping Trucks	$90.8	1,610,663		$56.39	
Ore Lifting Scrapers	$12.3	109,200		$112.41	
Ore Lifting Loader	$0.40	17,402		$22.98	
Ore Transport Trucks	$26.8	878,776		$31.71	
Fixed Costs	$357.3				
Waste Excavator Operators	$86.2	8	Employees	$90,540	$/yr
Waste Truck Operators	$201.5	24		$82,186	
Scraper Operators	$13.0	1		$90,540	
Ore Truck Operators	$56.5	6		$82,186	

For drilling and blasting, machine hours required to meet the mine schedule requirements are calculated and multiplied by an hourly unit cost. The cost of ANFO explosive is based on an assumed powder factor of 0.75 lb/y3.

Table 18-6: Drilling and Blasting OPEX

Area	LoM Cost - ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$153.6				
Drill Rig	$3.2	344,224	Hours	$90.59	$/hr
Drill Consumables	$21.2	84,700,871	Feet	$0.25	$/ft
ANFO	$64.7	196,066,832	Pounds	$0.33	$/lb
Explosive Consumables	$25.4	508,797,167	Tons	$0.05	$/t
Shot Truck	$1.1	35,241	Hours	$31.12	$/hr
Fixed Costs	$28.8				
Lead Blaster & Driller	$20.2	1	Employees	$169,650	$/yr
Drill & Blasting Laborer	$8.6	1		$72,173	

For mine support, a dozer, water truck, and grader, are assumed to each run part time to maintain benches and roads. This support fleet shares an operator each shift.

Table 18-7: Mine Support OPEX

Area	LoM Cost - ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$62.3				
Dozer	$46.9	350,895	Hours	$133.54	$/hr
Water Truck	$10.3	184,500		$55.76	
Grader	$5.1	184,500		$27.79	
Fixed Costs	$44.5				
Operators	$44.5	4	Employees	$90,540	$/yr

Mine maintenance for the equipment is assumed to be internal to the company. They support both the ore and waste mining fleets.

Table 18-8: Mine Maintenance OPEX

Area	LoM Cost - ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$5.9				
Fuel Truck	$2.9	123,000	Hours	$23.83	$/hr
Service Truck	$2.9	123,000		$23.83	
Fixed Costs	$41.0				
Mechanics	$23.3	2	Employees	$94,552	$/yr
Laborers	$17.8	2		$72,173	

Mine G&A is assumed to cover the salary cost of the Mine's management and technical support services.

Table 18-9: Mine G&A OPEX

Area	LoM Cost - ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	-				
Fixed Cost	$123.3				
Mine Manager	$23.4	1	Employees	$189,950	$/yr
Mine Foreman	$41.7	2		$169,650	
Engineer	$20.9	1		$169,650	
Geologist	$17.0	1		$138,475	
Survey / Technician	$20.3	2		$82,650	

18.1.4 Process Operating Cost

Table 18-10 contains a breakdown of the LoM operating costs for the process area.

Table 18-10: Process Operating Costs

Area	LoM Cost	Average Unit Cost
	($ Millions)	($/tonne processed)
Process Plant	$2,406	$276.48
Laboratory	$42.0	$4.83
Contingency (10%)	$244.8	$28.13
Total	$2,692	$309.44

The basis for the process operating costs is detailed in Table 18-11 through Table 18-12 and is similar in method to the mine operating costs. The process plant operational cost is based on an adjusted number for capacity of a Uranium-Vanadium SolvEx processing plant listed in the InfoMine database. The plant processes and contributing costs are comparable to the extraction processes of the Spor Mountain Plant. An additional wheel loader for feeding the mill is also included in the OPEX for the plant. Plant staffing numbers are based on Materion's current organization. Assumed salaries are based on the Uranium-Vanadium SolvEx plant InfoMine numbers.

Table 18-11: Process Plant OPEX

Area	LoM Cost ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$1,789				
Wheel Loader	$2.8	123,000	Hours	$22.98	$/hr
Process Plant	$1,786	8,700,751	Tons Processed	$205.32	$/t
Fixed Costs	$616				
Plant Production Mgr	$28.5	1	Employees	$231,565	$/yr
Plant Engineer	$21.8	1		$177,625	
Controller	$19.0	1		$154,643	
Foremen	$76.3	4		$155,005	
Operators	$223	20		$90,691	
Laborers	$36.2	4		$73,590	
Maint Planner/Foreman	$39.2	2		$159,210	
Mechanic	$75.0	6		$101,669	
Mechanic Helper	$59.4	6		$80,527	
Electrician	$12.7	1		$103,147	
Instrument Technician	$14.9	1		$121,075	
Secretary/Clerk	[illegible]	1		[illegible]	

Secretary/Clerk	$10.2	1		$82,650	

Laboratory staffing numbers and salaries are based on the Uranium-Vanadium SolvEx plant CostMine numbers.

Table 18-12: Laboratory OPEX

Area	LoM Cost ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs					
Supply - Total Cost	$1.2	8,700,751	Tons Processed	$0.08	$/t
Fixed Costs	$40.8				
Chief Chemist	$13.6	1	Employees	$110,490	$/yr
Technician	$27.2	2		$110,490	

18.1.5 Site G&A Costs

Site G&A costs include salaried employees that perform general and administrative tasks that involve both the mine and process areas such as a general manager, accountant, safety and environmental engineers, clerks and technicians, as well as annual costs such as computers, supplies, insurance & security. Table 18-13 details the buildup of the site G&A costs.

Table 18-13: Site G&A OPEX

Area	LoM Cost ($ Millions)	LoM Quantity	Units	Unit Costs	Units
Variable Costs	$7.6				
General	$4.4	8,700,751	Tons Processed	$0.50	$/t
Light Trucks	$3.3	59,000	hours	$17.69	$/hr
Fixed Costs	$157.7				
General Manager	$32.1	1	Employees	$261,000	$/yr
Accountant	$18.2	1		$147,900	
Safety / Environmental Engineer	$54.8	3		$148,509	
Warehouse/Purchasing	$32.3	2		$131,261	
Payroll/Clerk	$20.3	2		$82,650	